



# NOAA Technical Memorandum

## NMFS-SEFC-240

PRELIMINARY GUIDE TO THE IDENTIFICATION  
OF THE EARLY LIFE HISTORY STAGES OF SCOMBROID FISHES  
OF THE WESTERN CENTRAL ATLANTIC

by

WILLIAM J. RICHARDS

November 1989

U. S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
Southeast Fisheries Center  
Miami, Florida 33149

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Copies may be obtained by writing:

Dr. W. J. Richards  
National Marine Fisheries Service  
Southeast Fisheries Center  
75 Virginia Beach Drive  
Miami, FL 33149

National Technical  
Information Service  
or 5258 Port Royal Road  
Springfield, VA 22161

PRELIMINARY GUIDE TO THE IDENTIFICATION  
OF THE EARLY LIFE HISTORY STAGES OF SCOMBROID FISHES  
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William J. Richards

INTRODUCTION

This guide is intended for use as an identification guide to early life history specimens collected principally by plankton nets from marine waters of the western central Atlantic. This area is bounded by 35° north latitude on the north, 50° west longitude on the east, the Equator on the south, and the continental margins on the west. It is basically the area defined by FAO as the western central Atlantic Fishing Area 31 which includes the Gulf of Mexico and Caribbean Sea. The region is tropical and subtropical with important fishing areas and a high diversity of species. The area is also characterized by the large amounts of coral reefs.

This manual covers the eggs, larvae, and juveniles of the six families of fishes which form the perciform suborder Scombroidei. Among the fishes are some of the most important commercial and recreational fishes of the region. Because of the importance of these species much is known about their early life history (ELH). The manual provides information designed to identify these ELH stages which are generally collected by plankton nets. Larvae are much better known than the eggs because the eggs go through their developmental stages quite rapidly (24-48 hrs) and are all very similar in appearance. Success in identifying eggs depends on examining living eggs which is not easy for these generally high seas fishes. For each species an account on the left hand page gives information on meristics, ecology, and identification characters while on the facing page illustrations of critical stages are shown. Where information is not known space is provided so that as more is learned additions and notes can be easily added as this is meant to be a working manual. Much information on the ELH of fishes is given in the book 'Systematics and Ontogeny of Fishes' (Moser et al. 1984) and it should be used as a companion guide to this manual. Throughout this report references which are not found in the literature cited section may be found in the book. This was done to save space and time. A final version of this manual is planned which will include all families and have complete literature citations, but for this and forthcoming "preliminary" guides this practice will be followed.

I ask all users of this guide to notify me of all errors or omissions so that the final version will be complete. I thank at this time Jack C. Javech for new illustrations and Delilah Bermudez for her able assistance.

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### Family Scombrolabracidae

This monotypic family is related to the gempylids, but differs in the direction of the percoids. It has been placed in its own suborder by some, but it so closely resembles tuna larvae, that whatever its relationships are finally determined, it belongs with the scombroids for this purpose. The larvae are well described and could only be confused with tunas at small sizes.

## MERISTICS

Vertebrae	
Precaudal	13
Caudal	17
Total	30
Number of fin spines and rays	
First Dorsal	XII
Second Dorsal	15-16
Dorsal Finlets	0
Total Dorsal Elements	27-28
Anal	III, 15-17
Anal Finlets	0
Total Ventral Elements	18-20
Pectoral	18-19
Pelvic	1,5
Caudal	
Dorsal Secondary	7-9
Principal	9+8
Ventral Secondary	8-10
Total	34-36
Gillrakers on first arch	
Upper	Tooth Patches
Lower	4-5 + tooth patches
Total	4-5 + tooth patches
Branchiostegals	7

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning               Season: throughout year  
                          Area: throughout area  
                          Mode:  
                          Migration:  
Fecundity  
Age at first maturity  
Longevity

Literature: Potthoff et al. 1980

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

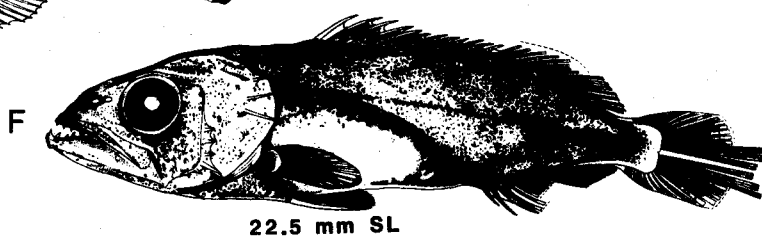
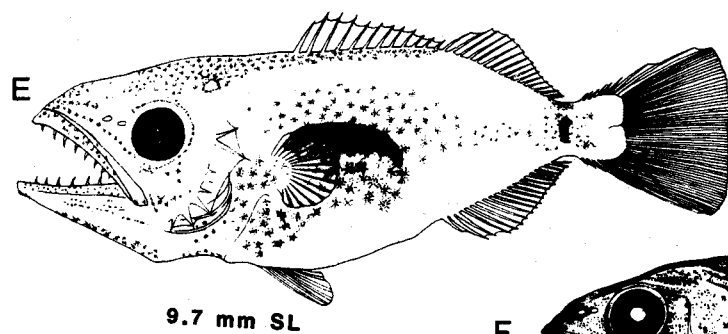
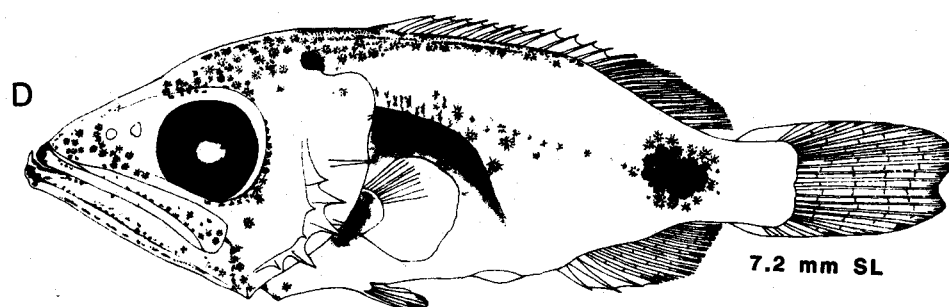
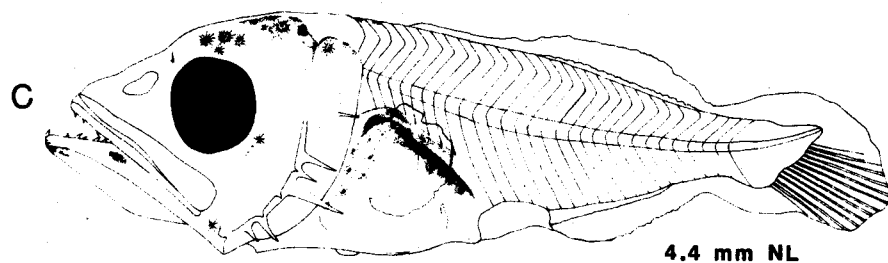
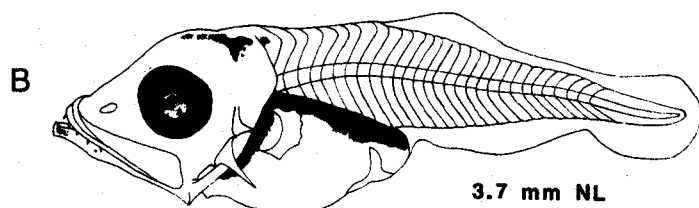
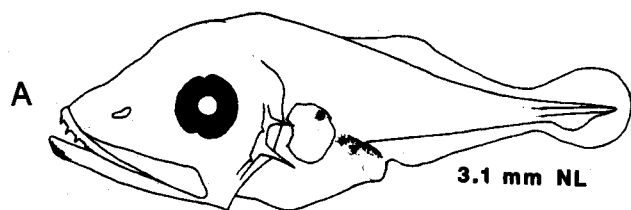
## LARVAE

Length at flexion: 4.2 - 5.3 mm NL  
Length at transformation: 14.7 mm SL  
Sequence of fin development: caudal, second dorsal, first dorsal, anal, pectoral, pelvic  
Pigment: tip lower jaw, midbrain, hindbrain, forebrain, over gut, rami of jaws, lateral on tail, pectoral symphysis (late)  
Diagnostic characters: myomeres separate from all other scombrids; most closely resembles *Thunnus* in shape and pigmentation at sizes <4.4 mm NL when forebrain and pectoral symphysis not developed; myomere count 30, not 39; cannot confuse with other scombrids because lacks ventral tail pigment.

Illustrations: A-F from Potthoff et al. 1980

*Scombrolabrax heterolepis*

SCOMBROLABRACIDAE





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## FAMILY SCOMBRIDAE

Because of their high economic importance they are among the best known of the fishes in our area and the World. sixteen species are known to spawn in our area and they are divided into 4 tribes - the Scombrini with one species: Scomber japonicus; the Scomberomorini with 5 species: Acanthocybium solandri, Scomberomorus brasiliensis, S. cavalla, S. maculatus, and S. regalis; the Sardini with 1 species: Sarda sarda; and the Thunnini with 9 species: Auxis rochei, A. thazard, Euthynnus alletteratus, Katsuwonus pelamis, Thunnus alalunga, T. albacares, T. atlanticus, T. obesus, and T. thynnus.

The eggs of those species that are known are all very similar and can only be separated when living based on pigment characters which are lost after preservation. Only minimal data are given in the accounts and the original sources should be carefully studied for egg identification.

The larvae are well known for all species except Scomberomorus brasiliensis. They are difficult to identify especially those in the genus Thunnus. The body shape, number of myomeres, and the melanistic pigment patterns must be carefully examined. For each tribe a summary of the critical characters is provided.



### Tribe Scombrini

Only one species spawns in our area - Scomber japonicus. It is quite unlike the other species of scombrids in that its first dorsal fin appears after the second dorsal and anal. It is most likely to be confused with the non-scombrids such as carangids or pomatomids. It does have the distinct triangular shaped gut, but it lacks the proportionately large head and jaws of the other tribes. Body shape, pigment pattern, and myomere counts will readily identify it.

## SCOMBRIDAE

Scomber japonicus Houttuyn

## MERISTICS

Vertebrae	
Precaudal	14
Caudal	17
Total	31
Number of fin spines and rays	
First Dorsal	9-13
Second Dorsal	11-12
Dorsal Finlets	4-5
Anal	1, 11-14
Anal Finlets	5
Pectoral	19-22
Pelvic	1, 5
Caudal	
Dorsal Secondary	10-11
Principal	9+8
Ventral Secondary	10-12
Total	37-39
Gillrakers on first arch	
Upper	
Lower	
Total	25-35
Branchiostegals	
First Closed Hemal Arch on Vertebrae	

## LIFE HISTORY

Range: east coast of U.S., Cuba, Venezuela  
Habitat: coastal pelagic, epipelagic or  
mesopelagic over continental shelf  
ELH pattern: oviparous, buoyant eggs, pelagic  
larvae

## Spawning:

Season: dependent on water temperature  
Area: throughout its range  
Mode: in batches of 250-300 eggs per female  
Migration: unknown

Fecundity: 100,000-400,000

Age at first maturity

Longevity

Literature: Collette and Nauen 1983

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 1.14-1.24 mm  
No. of Oil Globules: one  
Oil Globule Diameter: 0.28-0.32 mm  
Yolk: homogenous  
Shell: clear  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

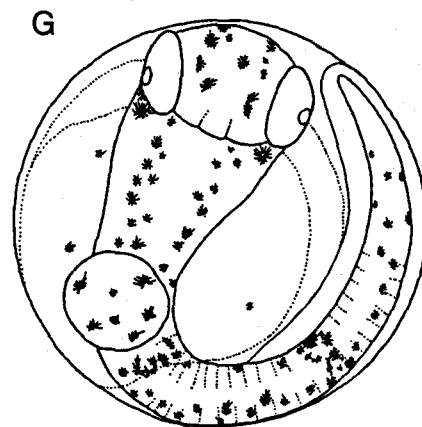
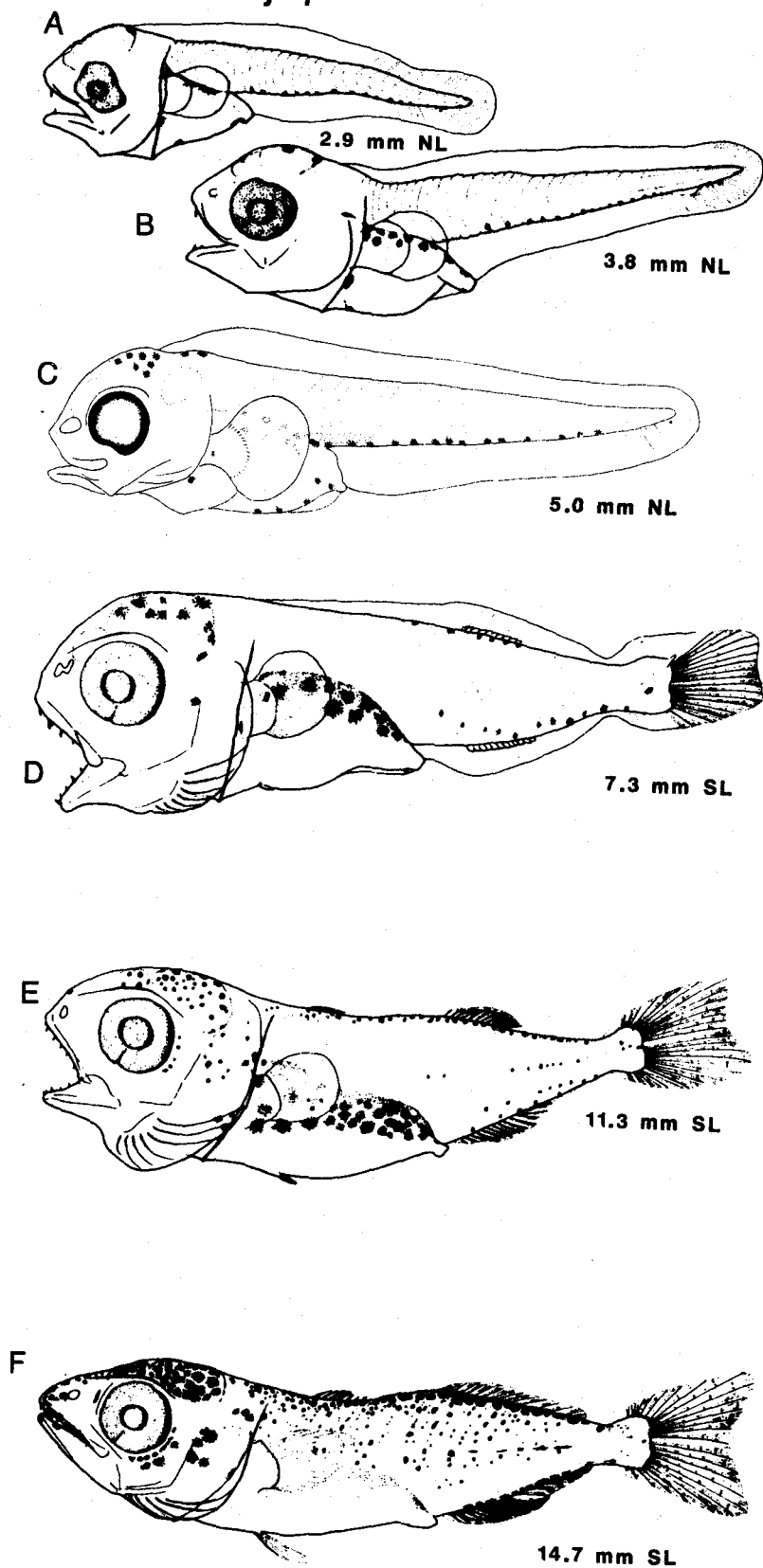
## LARVAE

Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, second  
dorsal, anal, pelvic, first dorsal,  
pectoral  
Pigment: midbrain, hindbrain, over gut, ventral  
margin of tail  
Diagnostic characters: pigment pattern and  
meristics (may be confused with non-  
scombrids such as carangids or  
pomatomids)  
Distinguish from other Scombrids: low myomere  
number, first dorsal fin appears late

Illustrations: A-B, D-F from Fahay 1983; C from  
Collette et al. 1984;  
G from Mayo 1973.

*Scomber japonicus*

SCOMBRIDAE



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### Tribe Scomberomorini

The two genera are easily separable because Acanthocybium is very unique with no other larvae appearing like it. The four species of Scomberomorus present some problems. Myomeres, pigment patterns, and the long preopercular spine readily separates S. cavalla from the others. Unfortunately the others are sympatric over parts of their ranges and share many critical features. The recently described S. brasiliensis is still undescribed in ELH stages, but more critical work is needed with S. regalis since its description is based on reared material which usually is more melanistic than wild-caught material. Care must be taken not to confuse any of these species with Sarda because they share the supraoccipital crest, high myomere counts, and pigment pattern.



## SCOMBRIDAE

Acanthocybium solandri (Cuvier)

## MERISTICS

---

Vertebrae		
Precaudal		30-32
Caudal		31-33
Total		62-64
Number of fin spines and rays		
First Dorsal		23-27
Second Dorsal		11-16 usually 13
Dorsal Finlets		7-10
Anal		11-14
Anal Finlets		7-10
Pectoral		22-26
Pelvic		1,5
Caudal		
	Dorsal Secondary	
	Principal	9+8
	Ventral Secondary	
	Total	
Gillrakers on first arch		
	Upper	
	Lower	
	Total	Absent
Branchiostegals		
First Closed Hemal Arch on Vertebrae		

---

## LIFE HISTORY

---

Range: throughout Area  
Habitat: epipelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning      Season: probably long, but larvae rare  
                 Area: throughout its range  
                 Mode:  
                 Migration: unknown  
Fecundity  
Age at first maturity  
Longevity

---

Literature: Collette and Nauen 1983

## EARLY LIFE HISTORY DESCRIPTION

---

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size: 2.5 mm  
Incubation  
Pigment  
Diagnostic characters

---

## LARVAE

Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, first dorsal, second dorsal, anal, pectoral, pelvics  
Pigment: jaw tips, nasal area, fore- and midbrain, over gut, ventral spot on tail, spot under second dorsal  
Diagnostic characters: long snout and high number of myomeres (62-64)  
Distinguish from Scomberomorus and Sarda-higher number of myomeres, less pigmentation  
Distinguish from other Scombrids-pigment, snout length, myomeres

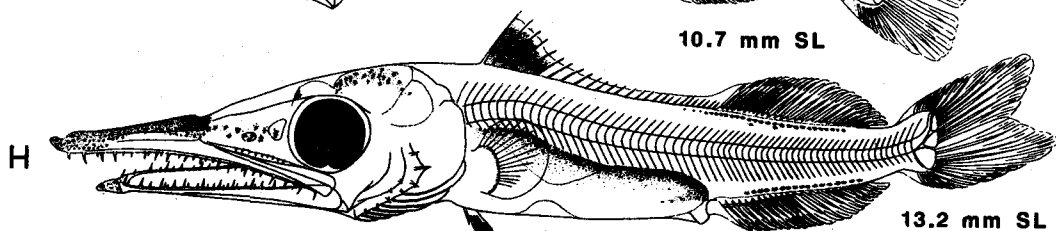
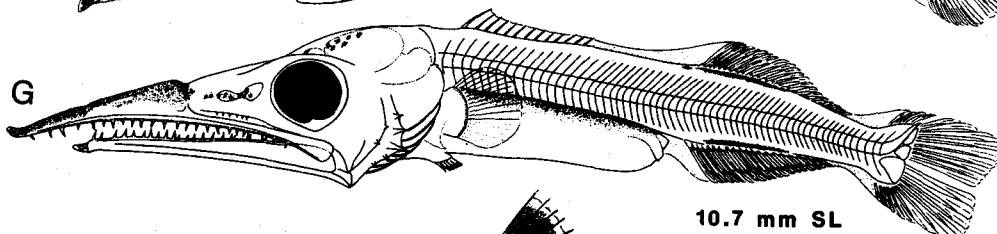
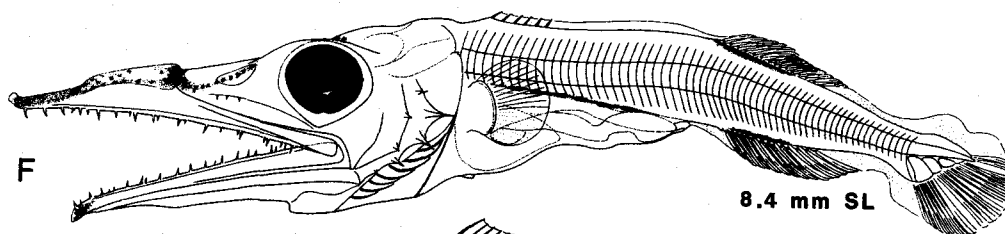
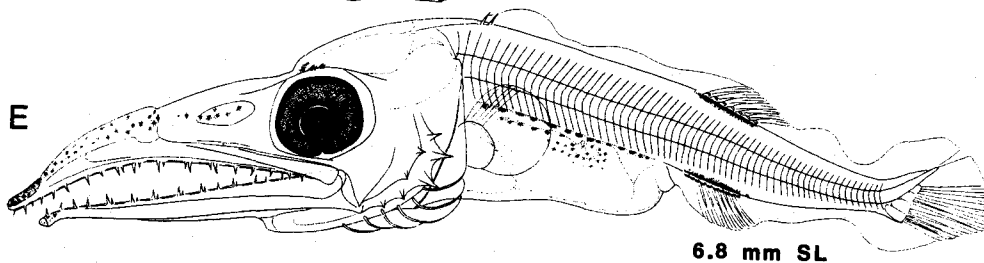
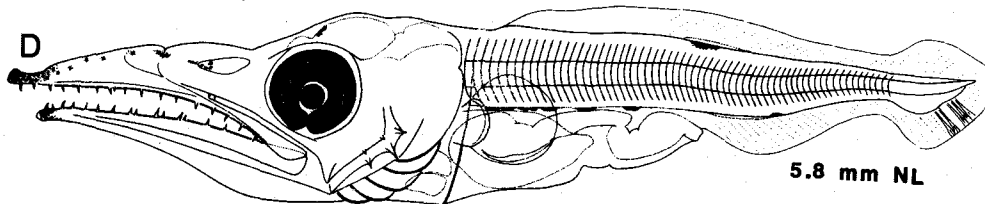
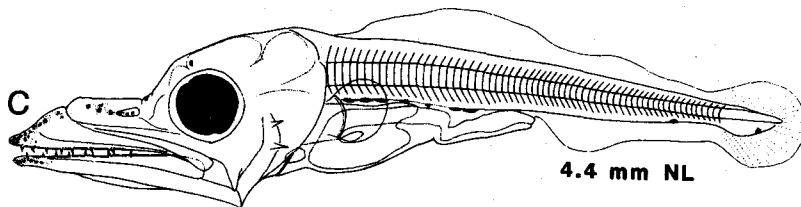
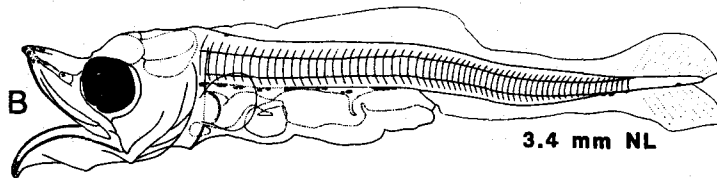
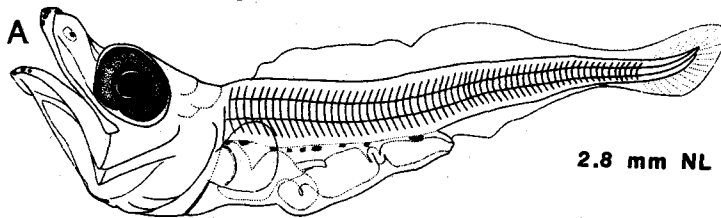
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Illustrations: A-H from Matsumoto 1967

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*Acanthocybium solandri*

SCOMBRIDAE



## SCOMBRIDAE

Scomberomorus brasiliensis Collette, Russo  
& Zavalla-Camin

## MERISTICS

Vertebrae	
Precaudal	19-21
Caudal	27-29
Total	47-49
Number of fin spines and rays	
First Dorsal	17-19
Second Dorsal	15-19
	usually 17-18
Dorsal Finlets	8-10
Anal	16-20
Anal Finlets	7-10
Pectoral	21-24
Pelvic	1,5
Caudal	
Dorsal Secondary	11-13
Principal	9+8
Ventral Secondary	11-13
Total	39-43
Gillrakers on first arch	
Upper	
Lower	
Total	11-16
Branchiostegals	

## LIFE HISTORY

Range: continental coast of Quintano Roo, Mexico  
southward

Habitat: coastal epipelagic, neritic

ELH pattern: oviparous, buoyant eggs, pelagic  
larvae

Spawning      Season:  
                 Area:  
                 Mode:  
                 Migration:

Fecundity

Age at first maturity

Longevity

Literature: Collette and Nauen 1983

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment

Diagnostic characters

LARVAE: unknown  
Length at flexion  
Length at transformation  
Sequence of fin development  
Pigment  
Diagnostic characters: myomeres will not  
separate it from S. regalis  
Distinguish from other Scombrids

Illustrations:

***Scomberomorus brasiliensis***

**SCOMBRIDAE**

## SCOMBRIDAE

Scomberomorus cavalla (Cuvier)

## MERISTICS

Vertebrae	
Precaudal	16-17
Caudal	24-26
Total	41-43
Number of fin spines and rays	
First Dorsal	12-18 usually 15
Second Dorsal	15-18
Dorsal Finlets	7-10
Anal	16-20
Anal Finlets	7-10
Pectoral	21-23
Pelvic	1,5
Caudal	
Dorsal Secondary	11-13
Principal	9+8
Ventral Secondary	11-13
Total	39-43
Gillrakers on first arch	
Upper	
Lower	
Total	7-13
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: coastal epipelagic, neritic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning:  
  Season: summer months to early fall  
  Area: throughout area  
  Mode:  
  Migration: extensive movements  
Fecundity  
Age at first maturity  
Longevity

Literature: Collette and Nauen 1983

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 0.90- 0.98 mm  
No. of Oil Globules: one  
Oil Globule Diameter: 0.30-0.32 mm  
Yolk: homogenous  
Shell: unsculptured  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

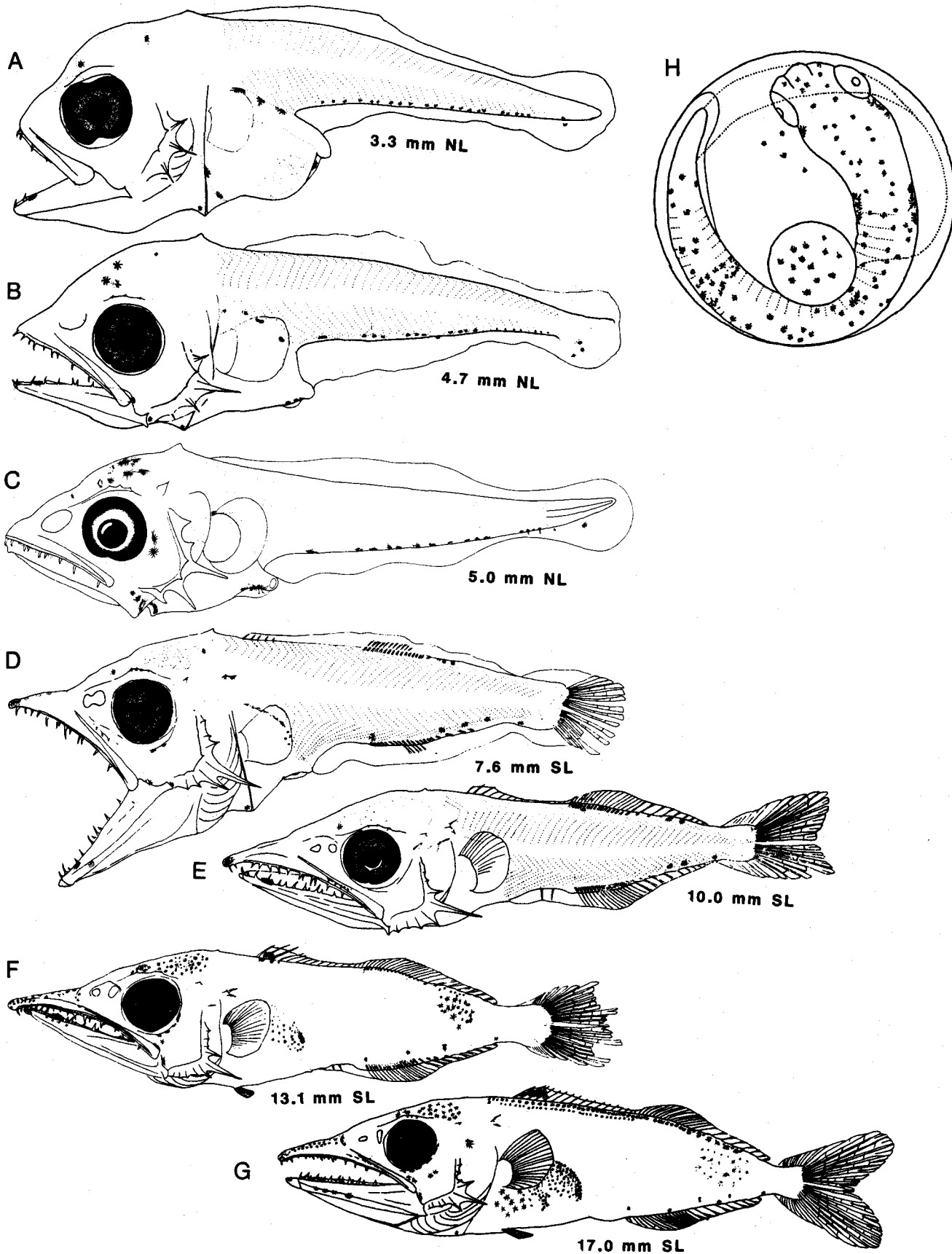
## LARVAE

Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, first dorsal, second dorsal, anal, pectoral, pelvic  
Pigment: pigment on forebrain, midbrain, over gut, cleithral symphysis, ventral margin of tail, distinct patch on each side of tongue  
Diagnostic characters: from other Scomberomorus low myomere number, very long preopercular spine, and pigment by tongue  
Distinguish from other scombrids: presence of supraoccipital crest, myomeres, long preopercular spine, and pigment pattern

Illustrations: A-B,D-G from Wollam 1970; C from Collette et al 1984; H from Mayo 1973

*Scomberomorus cavalla*

SCOMBRIDAE



## SCOMBRIDAE

Scomberomorus maculatus (Mitchill)

## MERISTICS

Vertebrae		
Precaudal		21-22
Caudal		30-31
Total		51-53
Number of fin spines and rays		
First Dorsal		17-19
Second Dorsal		17-20
Dorsal Finlets		7-9
Anal		17-20
Anal Finlets		7-10
Pectoral		20-23
Pelvic		1,5
Caudal		
Dorsal Secondary		11-13
Principal		9+8
Ventral Secondary		11-13
Total		39-43
Gillrakers on first arch		
Upper		
Lower		
Total		10-16
Branchiostegals		

## LIFE HISTORY

Range: east coast U.S., Gulf, Bermuda  
Habitat: coastal epipelagic, neritic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae

## Spawning:

Season: summer months to early fall  
Area: throughout area  
Mode:  
Migration: extensive movements

## Fecundity

Age at first maturity

Longevity

Literature: Collette and Nauen 1983

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 0.9-1.3 mm

No. of Oil Globules: one

Oil Globule Diameter

Yolk: homogenous

Shell: unsculptured

Hatch Size: 2.56 mm NL

Incubation: 15.5 hrs at 29°C; 24-25 hrs at 25-26°C

Pigment

Diagnostic characters

## LARVAE

Length at flexion: ca. 6 mm

Length at transformation

Sequence of fin development: caudal, first dorsal, second dorsal, anal, pectoral, pelvic

Pigment: pigment on forebrain, midbrain, over gut, cleithral symphysis, ventral margin of tail, usually a distinct patch on gular area

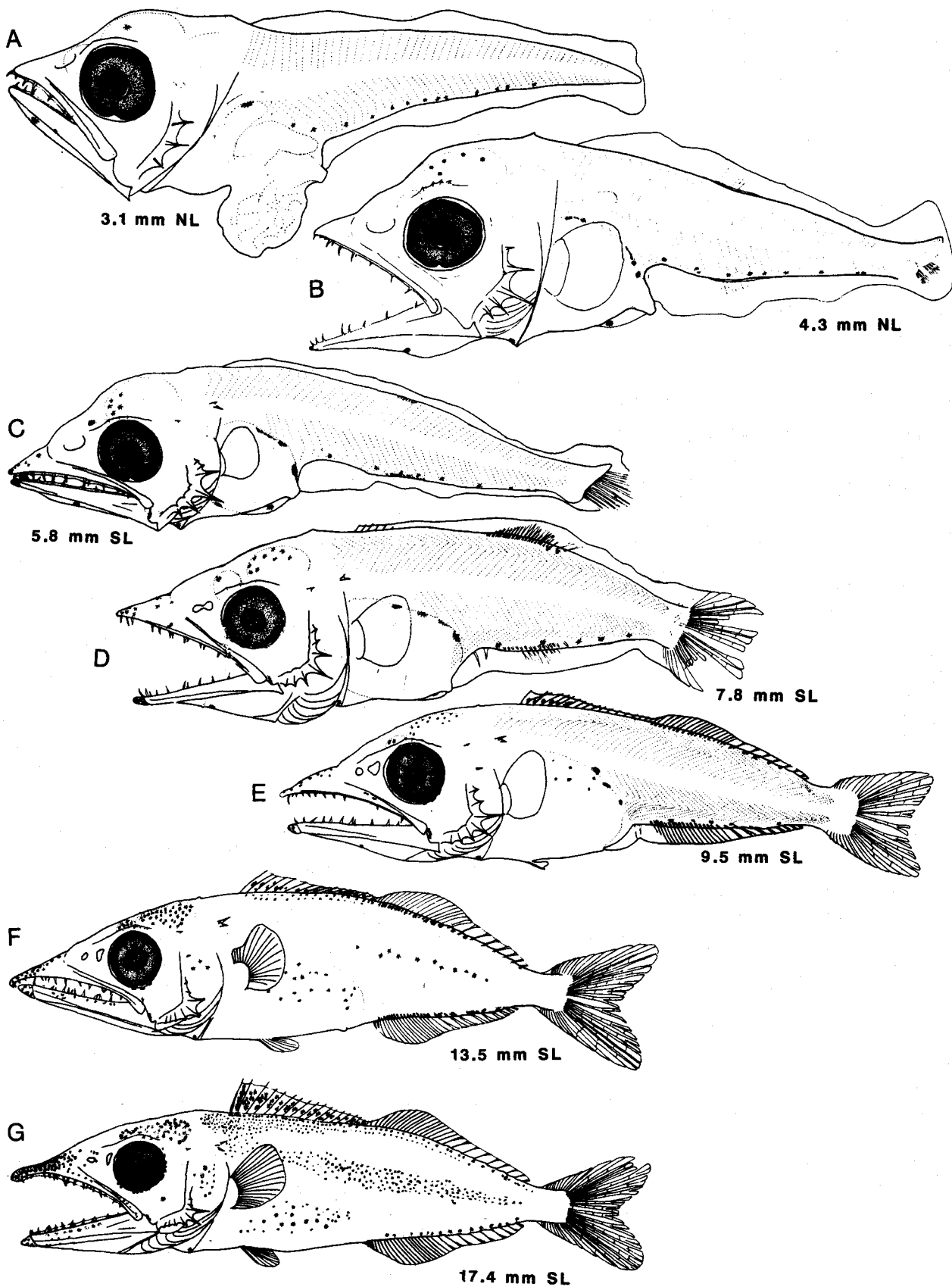
Diagnostic characters: from other Scomberomorus myomere number, and pigment by gular area

Distinguish from Sarda sarda by pigment pattern and from other scombrids by presence of supraoccipital crest, myomeres, and pigment pattern

Illustrations: A-G from Wollam 1970

*Scomberomorus maculatus*

SCOMBRIDAE





## SCOMBRIDAE

Scomberomorus regalis (Bloch)

## MERISTICS

Vertebrae	
Precaudal	19-20
Caudal	28
Total	47-48
Number of fin spines and rays	
First Dorsal	16-18
Second Dorsal	16-19
Dorsal Finlets	7-9
Anal	15-20
	usually 18-19
Anal Finlets	7-10
Pectoral	20-24
Pelvic	1,5
Caudal	
Dorsal Secondary	11-13
Principal	9+8
Ventral Secondary	11-13
Total	39-43
Gillrakers on first arch	
Upper	
Lower	
Total	12-18
Branchiostegals	

## LIFE HISTORY

Range: east coast U.S., northwestern Gulf, Yucatan, Antilles, northern coast of South America

Habitat: coastal epipelagic around clear waters around coral reefs

ELH pattern: oviparous, buoyant eggs, pelagic larvae

Spawning      Season:  
                 Area:  
                 Mode:  
                 Migration:

Fecundity

Age at first maturity

Longevity

Literature: Collette and Nauen 1983; Mayo 1973

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 1.16-1.22 mm

No. of Oil Globules: one

Oil Globule Diameter: 0.34-0.36 mm

Yolk: homogenous

Shell: unsculptured

Hatch Size: 3.4 mm NL

Incubation

Pigment: Mayo 1973 provides life colors

Diagnostic characters

## LARVAE

Length at flexion: ca. 7 mm

Length at transformation

Sequence of fin development: caudal, first dorsal, second dorsal, anal, pectoral, pelvic

Pigment: pigment on forebrain, midbrain, over gut cleithral symphysis, ventral margin of tail, distinct patch on gular area

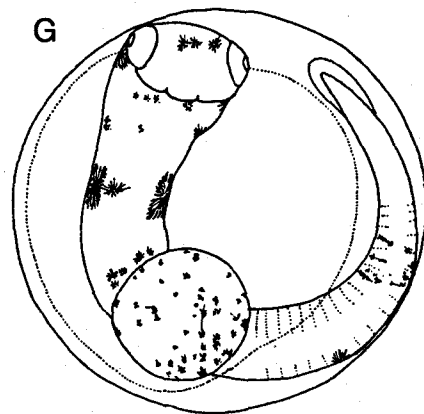
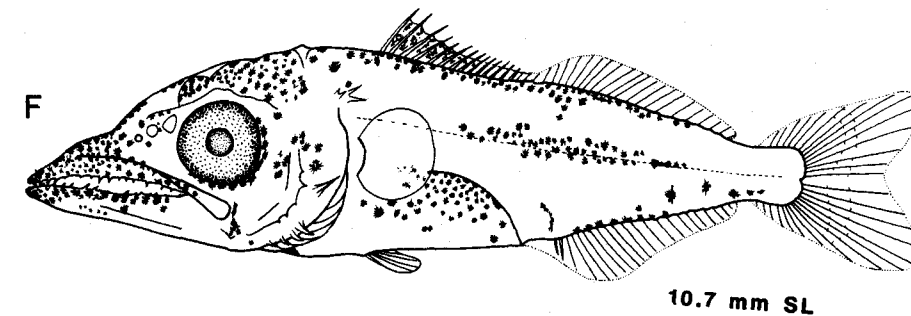
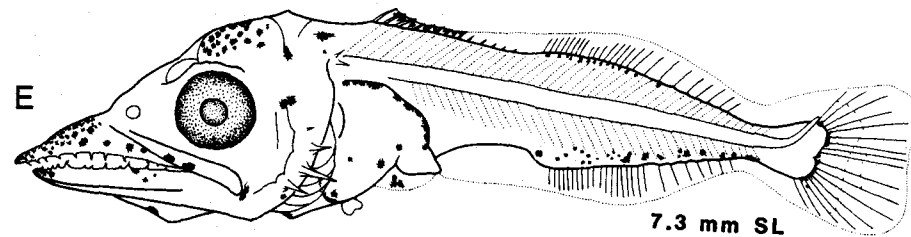
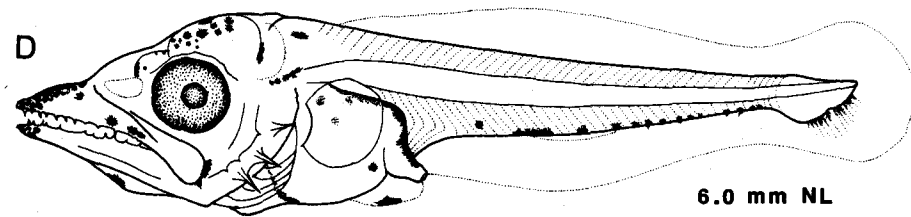
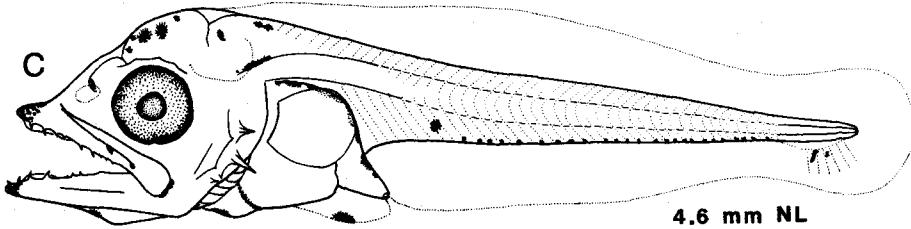
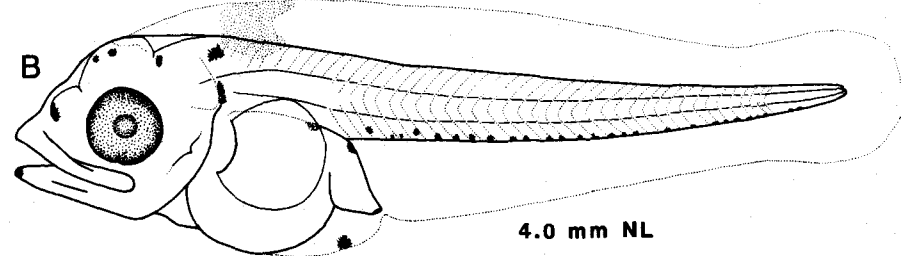
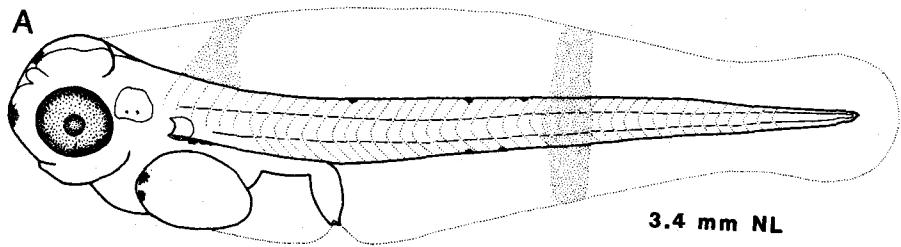
Diagnostic characters: from other Scomberomorus by myomere number, and pigment by gular area, but myomere number will not distinguish from S. brasiliensis

Distinguish from Sarda sarda by pigment pattern and myomeres and from other Scombrids by presence of supra-occipital crest, myomeres, and pigment pattern

Illustrations: A-G from Mayo 1973

*Scomberomorus regalis*

SCOMBRIDAE



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### Tribe Sardini

Only one species, Sarda sarda, is found in our area, but it may be confused with Scomberomorus species because of sharing of high number of myomeres and a supraoccipital crest. One interesting feature is the tendency for the ventral melanophores to migrate internally along the myosepta and the usual presence of melanophores on the hypural plate area. Both occur inshore so great care must be exercised.

## SCOMBRIDAE

Sarda sarda (Bloch)

## MERISTICS

Vertebrae	
Precaudal	26-28
Caudal	23-26
Total	50-53
Number of fin spines and rays	
First Dorsal	20-23 usually 21
Second Dorsal	13-18 usually 15-16
Dorsal Finlets	7-9
Anal	14-16
Anal Finlets	6-8
Pectoral	23-26
Pelvic	1,5
Caudal	
Dorsal Secondary	
Principal	
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	16-22
Branchiostegals	
First Closed Hemal Arch on Vertebrae	

## LIFE HISTORY

Range: rare throughout our area and absent from much of the Caribbean

Habitat: epipelagic, neritic, schooling

ELH pattern: oviparous, buoyant eggs, pelagic larvae

Spawning      Season:  
                 Area:  
                 Mode:  
                 Migration:

Fecundity

Age at first maturity

Longevity

Literature: Collette and Nauen 1983; Fritzsche 1978

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 1.15-1.57 mm

No. of Oil Globules: variable 1-9

Oil Globule Diameter: 0.28-0.364 when single;  
0.02-0.24 multiple

Yolk: homogenous

Shell: clear

Hatch Size: ca. 4 mm

Incubation: 1-1.5 days

Pigment

Diagnostic characters

## LARVAE

Length at flexion: 6.4 mm

Length at transformation

Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral

Pigment: present on tips of jaws, forebrain, midbrain, gut, pectoral symphysis, ventral margin of tail, usually over hypural plate area, and pelvic rays

Diagnostic characters: separate from

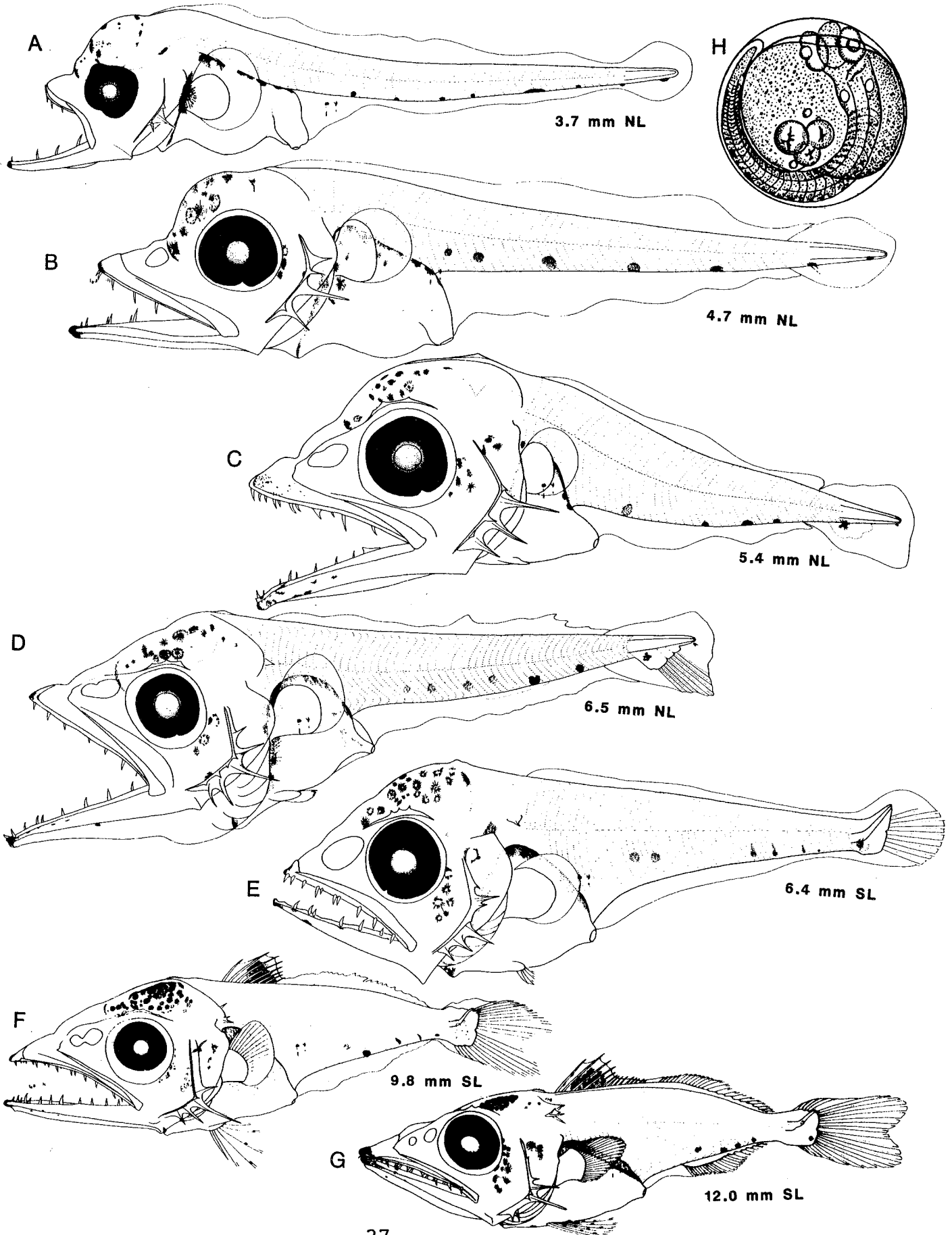
Scomberomorus maculatus by pigment over hypural plate and ventral pigment areas move up internally between myomeres; from other Scomberomorus by myomeres

Distinguish from other Scombrids by supra-occipital crest, myomeres, and pelvics pigmented

Illustrations: A-D, F-G Original; E from Collette et al. 1984; H from Sanzo 1932

*Sarda sarda*

SCOMBRIDAE



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### Tribe Thunnini

These are the most difficult larvae to identify. Their large heads, triangular guts, large jaws, and lack of pigment separate them from other larvae found in oceanic areas. Only Scombrolabrax and a few myctophids of the genus Lampanyctus are ever confused with these species. First, the two species of Auxis are difficult to separate as adults and their taxonomy is still in question. For practical purposes they are usually identified only to genus. Small specimens resemble Euthynnus and care must be used to separate them as they commonly co-occur. At small sizes the presence of hindbrain pigment in Auxis will be diagnostic. Euthynnus has a lot of lower jaw pigment which is unique for the group. Katsuwonus larvae have forebrain pigment at very small sizes thus separating them from Thunnus which share a lack of tail pigment. Occasionally Katsuwonus larvae will have a single pigment spot on the dorsal edge of the caudal peduncle which results in confusion with T. thynnus, but forebrain pigment will separate them. The great difficulty is within Thunnus. To have any reliability at all, one must clear and stain specimens to check the vertebral precaudal/caudal count and position of the first closed hemal arch after first documenting the position of melanophores on the jaw tips and tail. Only T. thynnus has dorsal tail pigment and rarely lateral pigment. However, in specimens > 7 mm SL juvenile pigment may start to appear leading to erroneous conclusions. I recommend the necessity of clearing and staining all specimens larger than 7 mm SL. Even then one cannot be absolutely certain because of variation. Pigment is quite reliable except that the commonness Thunnus in our area, T. atlanticus, has two morphs - one with ventral pigment and one without. Clearing and staining will verify its identity in most cases. T. albacares and T. obesus cannot be separated by clearing and staining, so pigment presence or absence is the only criterion available. Very small larvae have ventral pigment which quickly migrates or disappears which greatly complicates identifying them. As a result sometimes significant numbers can only be identified to the generic level.



## SCOMBRIDAE

Auxis rochei (Risso)

## MERISTICS

Vertebrae	
Precaudal	20
Caudal	19
Total	39
Number of fin spines and rays	
First Dorsal	10-12
Second Dorsal	10-12
Dorsal Finlets	7-9
Anal	11-14
Anal Finlets	7
Pectoral	23-25
Pelvic	1,5
Caudal	
Dorsal Secondary	15
Principal	9+8
Ventral Secondary	16
Total	48
Gillrakers on first arch	
Upper	
Lower	
Total	36-47
Branchiostegals	
First Closed Hemal Arch on Vertebrae	

## LIFE HISTORY

Range: throughout our area  
Habitat: epipelagic, neritic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae

Spawning:  
    Season: throughout the year  
    Area: throughout the area  
    Mode:  
    Migration:

Fecundity  
Age at first maturity  
Longevity

Literature: Collette and Nauen 1983; Richards  
et al. 1984; Kelley et al. 1986;  
Mayo 1973

## EARLY LIFE HISTORY DESCRIPTION

EGGS: based on Mayo 1973 type a  
Diameter: 0.82-0.88 mm  
No. of Oil Globules: one  
Oil Globule Diameter: 0.24-0.25 mm  
Yolk: homogenous  
Shell: clear  
Hatch Size: 2.14 mm NL  
Incubation  
Pigment: green chromatophores and melanophores on embryo; 6-14 stellate bodies on oil globule  
Diagnostic characters: size and pigmentation

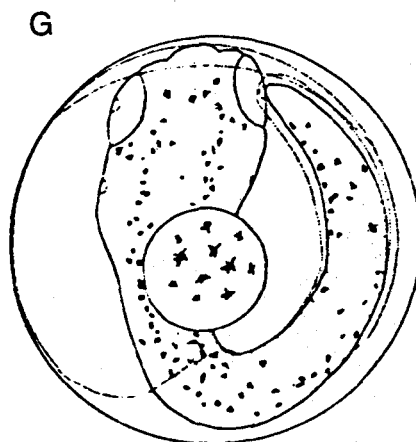
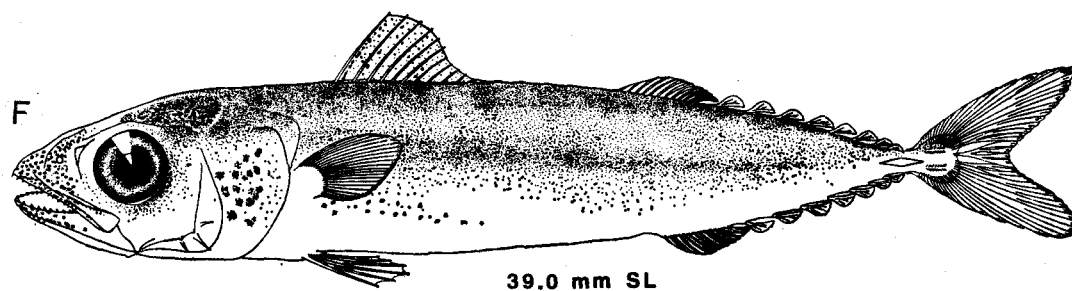
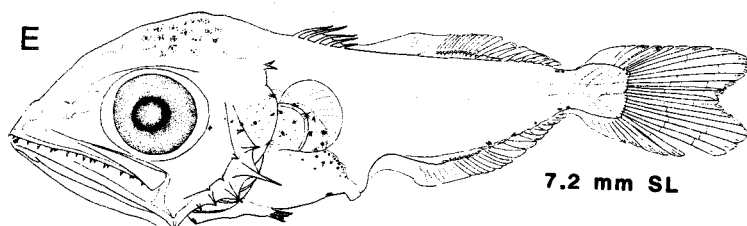
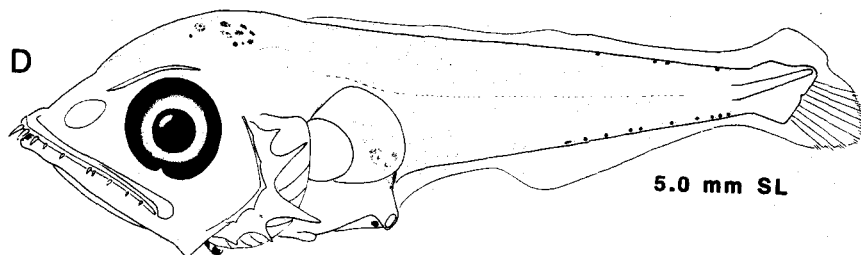
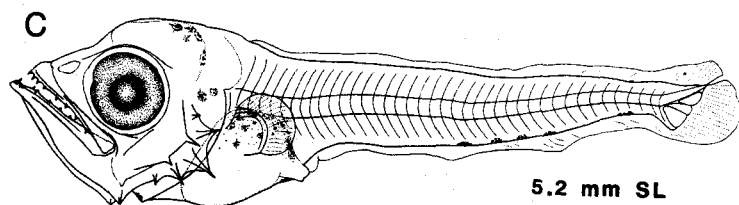
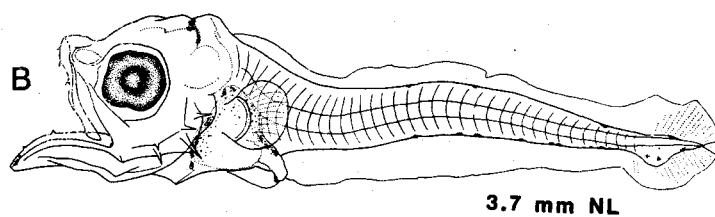
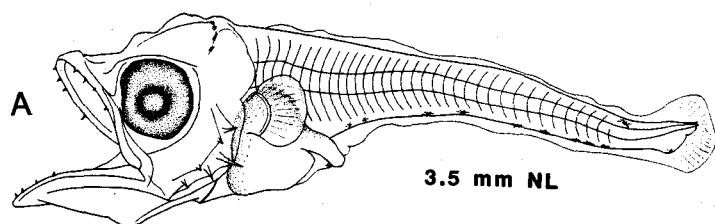
## LARVAE

Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral  
Pigment: present on midbrain, hindbrain, gut, pectoral symphysis, dorsal and ventral margins of tail  
Diagnostic characters: separate from A. thazard (type I) by lack of pigment along lateral line on tail; from Thunnus, Katsuwonus, and Euthynnus by pigment pattern  
Distinguish from other scombrids by pigment pattern and myomeres

Illustrations: A-C, E from Matsumoto 1959; D from Collette et al. 1984; F from Matsumoto 1961; G from Mayo 1973

*Auxis rochei*

SCOMBRIDAE



## SCOMBRIDAE

Auxis thazard (Lacepde)

## MERISTICS

Vertebrae	
Precaudal	20
Caudal	19
Total	39
Number of fin spines and rays	
First Dorsal	10-12
Second Dorsal	10-12
Dorsal Finlets	7-9
Anal	11-14
Anal Finlets	7
Pectoral	23-25
Pelvic	1,5
Caudal	
Dorsal Secondary	15
Principal	9+8
Ventral Secondary	16
Total	48
Gillrakers on first arch	
Upper	
Lower	
Total	36-47
Branchiostegals	
First Closed Hemal Arch on Vertebrae	

## LIFE HISTORY

Range: throughout our area  
Habitat: epipelagic, neritic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae

## Spawning:

Season: throughout the year  
Area: throughout the area  
Mode:  
Migration:

## Fecundity

Age at first maturity  
Longevity

Literature: Collette and Nauen 1983

## EARLY LIFE HISTORY DESCRIPTION

EGGS: based on Mayo 1973 type b  
Diameter: 0.84-0.92 mm  
No. of Oil Globules: one  
Oil Globule Diameter: 0.24-0.29 mm  
Yolk: homogenous  
Shell: clear  
Hatch Size: 2.32 mm NL  
Incubation  
Pigment: large green chromatophores on posterior half of embryo, melanophores as in Auxis rochei (type a)  
Diagnostic characters: size and pigmentation

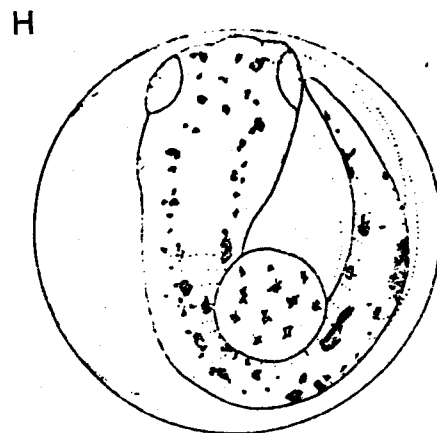
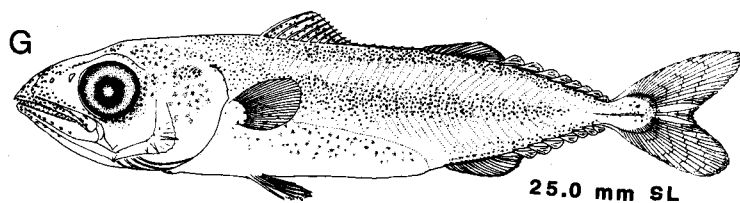
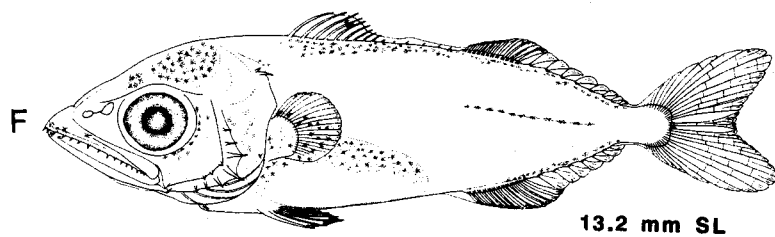
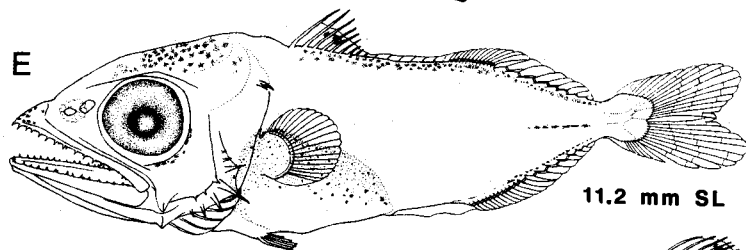
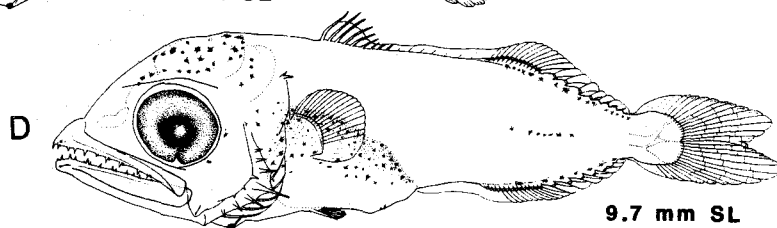
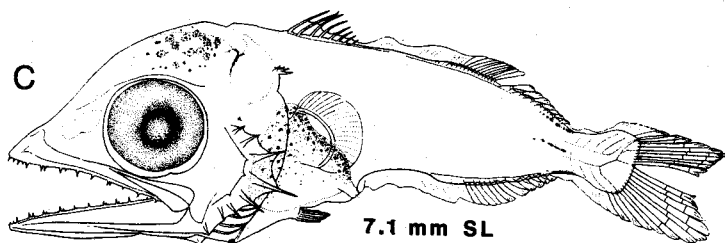
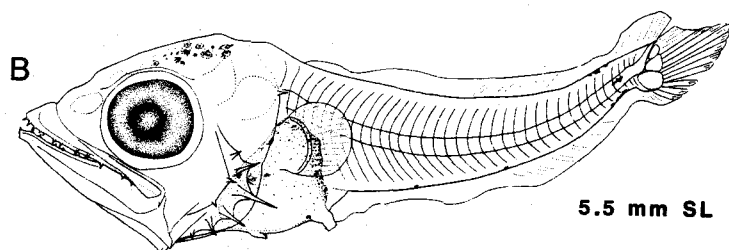
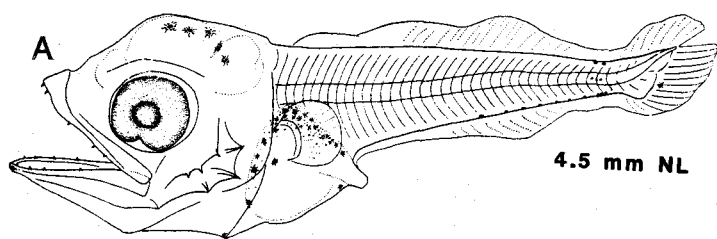
## LARVAE

Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral  
Pigment: present on midbrain, hindbrain, gut, pectoral symphysis, dorsal, lateral, and ventral margins of tail  
Diagnostic characters: separate from A. rochei (type II) by presence of pigment along lateral line on tail; from Thunnus, Katsuwonus, and Euthynnus by pigment pattern  
Distinguish from other Scombrids by pigment pattern and myomeres

Illustrations: A-G from Matsumoto 1959; H from Mayo 1973

*Auxis thazard*

SCOMBRIDAE



## SCOMBRIDAE

Euthynnus alletteratus (Rafinesque)

## MERISTICS

Vertebrae	
Precaudal	20
Caudal	19
Total	39
Number of fin spines and rays	
First Dorsal	13-17
Second Dorsal	11-13
Dorsal Finlets	8-9
Anal	11-15
Anal Finlets	7-8
Pectoral	25-29
Pelvic	1,5
Caudal	
Dorsal Secondary	15-16
Principal	9+8
Ventral Secondary	14-16
Total	47-49
Gillrakers on first arch	
Upper	
Lower	
Total	37-45
Branchiostegals	
First Closed Hemal Arch on Vertebrae	

## LIFE HISTORY

Range: throughout Area  
Habitat: epipelagic, neritic-typically inshore  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning:  
    Season: warm months  
    Area: throughout area  
    Mode: schools  
    Migration: unknown  
Fecundity  
Age at first maturity  
Longevity

Literature: Collette and Nauen 1983; Richards et al. 1984; Kelley et al. 1986; Mayo 1973

## EARLY LIFE HISTORY DESCRIPTION

EGGS: based on Mayo 1973  
Diameter: 0.84-0.94 mm  
No. of Oil Globules: one  
Oil Globule Diameter: 0.24-0.34 mm  
Yolk: homogenous  
Shell: clear  
Hatch Size: 2.5 mm  
Incubation Time/Temp: 48 hrs at 26°C  
Pigment: light yellow chromatophores-1 to 3 on oil globule, 2 between oil globule and ventral surface of notochord, 1 posterior to each optic cup, 2 block-like anterior end of notochord; melanin appears scattered before hatching  
Diagnostic characters: size and pigmentation

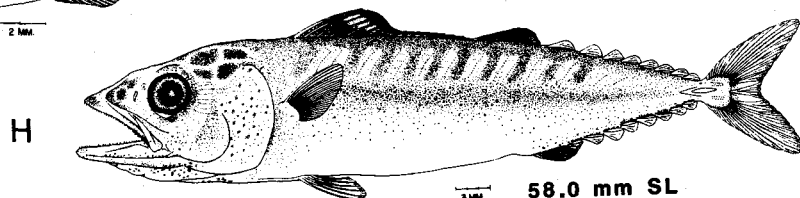
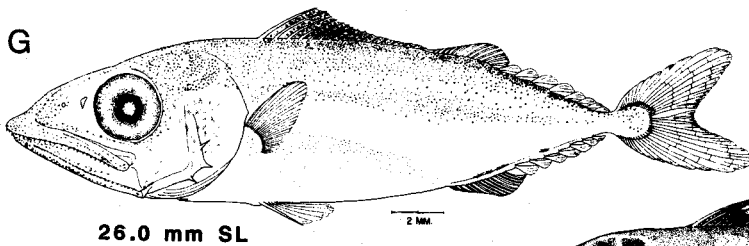
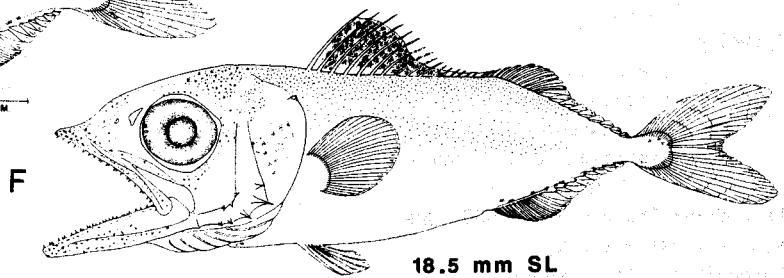
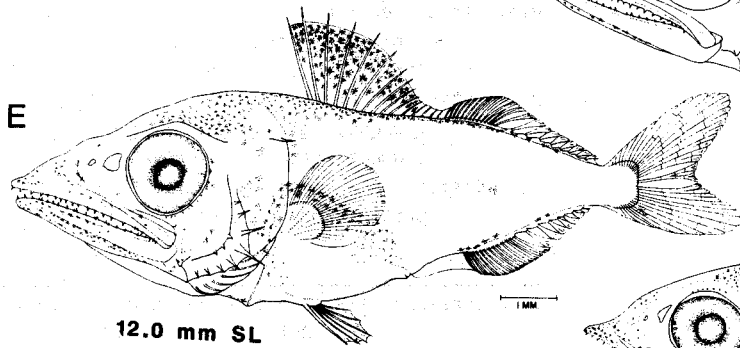
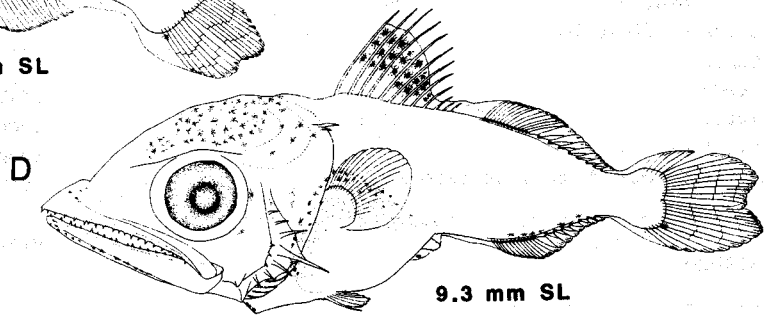
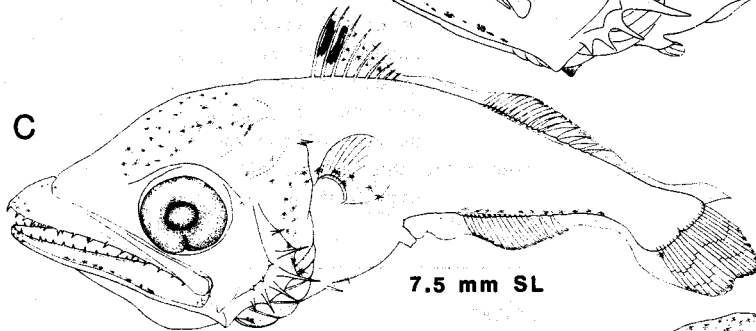
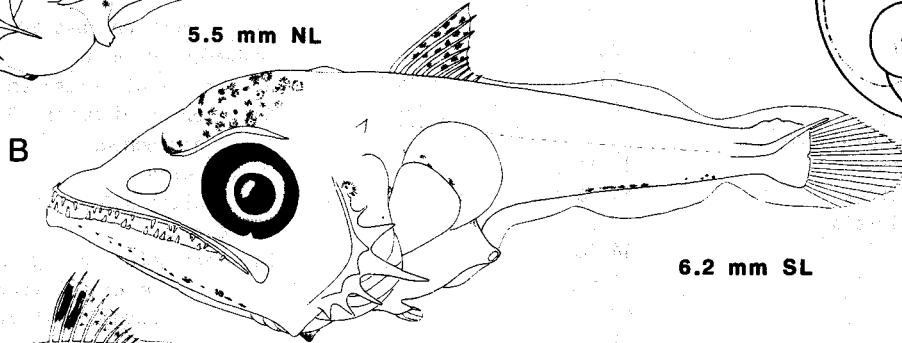
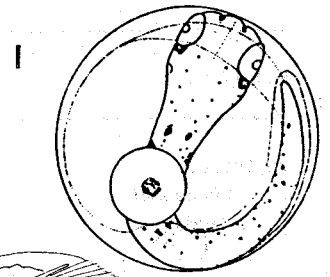
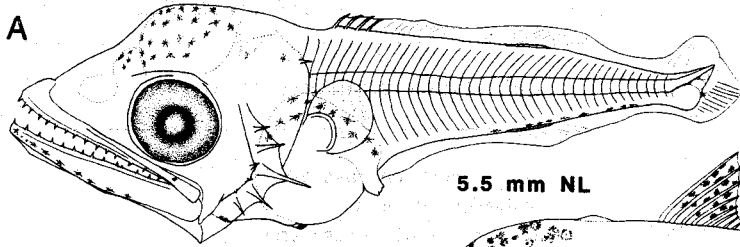
## LARVAE

Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral  
Pigment: present on forebrain, midbrain, tips of both jaws, ramus of lower jaw, cleithral symphysis, ventral margin of tail, first dorsal  
Diagnostic characters: unique combination of pigment patterns  
Distinguish from Auxis-forebrain and lower jaw ramus pigment, well developed first dorsal pigmented  
Distinguish from Katsuwonus-cleithral symphysis and lower jaw symphysis, well developed first dorsal pigmented  
Distinguish from Thunnus-forebrain and cleithral symphysis pigmented  
Distinguish from other scombrids-pigment, myomeres

Illustrations: A,C-H from Matsumoto 1959; B from Collette et al 1984; I from Mayo 1973

*Euthynnus alletteratus*

SCOMBRIDAE



## SCOMBRIDAE

Katsuwonus pelamis (Linnaeus)

## MERISTICS

Vertebrae	
Precaudal	20
Caudal	21
Total	41
Number of fin spines and rays	
First Dorsal	14-16
Second Dorsal	14-16
Dorsal Finlets	7-8
Anal	14-16
Anal Finlets	6-8
Pectoral	26-28
Pelvic	1,5
Caudal	
Dorsal Secondary	16-17
Principal	9+8
Ventral Secondary	17-18
Total	50-51
Gillrakers on first arch	
Upper	
Lower	
Total	51-63
Branchiostegals	
First Closed Hemal Arch on Vertebrae	

## LIFE HISTORY

Range: throughout area  
 Habitat: epipelagic, oceanic  
 ELH pattern: oviparous, buoyant eggs, pelagic larvae  
 Spawning:  
   Season: throughout the year in tropics  
   Area: throughout area  
   Mode: batch  
   Migration: occurs, but not known in our area  
 Fecundity: 255,000-1,331,000 eggs  
 Age at first maturity  
 Longevity: 8 to 12 years

Literature: Collette and Nauen 1983, Simmons 1969; Richards et al. 1984; Kelley et al. 1986; Mayo 1973; Matsumoto et al. 1984

## EARLY LIFE HISTORY DESCRIPTION

EGGS: based on Mayo 1973  
 Diameter: 0.94 mm  
 No. of Oil Globules: one  
 Oil Globule Diameter: 0.26 mm  
 Yolk: homogenous  
 Shell: clear  
 Hatch Size: 3.0 mm NL  
 Incubation  
 Pigment: golden oil globule; yellow chromatophores on dorsal finfold, behind optic cups, between oil globule and notochord, and rarely on dorsal surface of oil globule; stellate melanophores on dorsolateral surface of embryo  
 Diagnostic characters: oil globule golden, pigmentation pattern, size

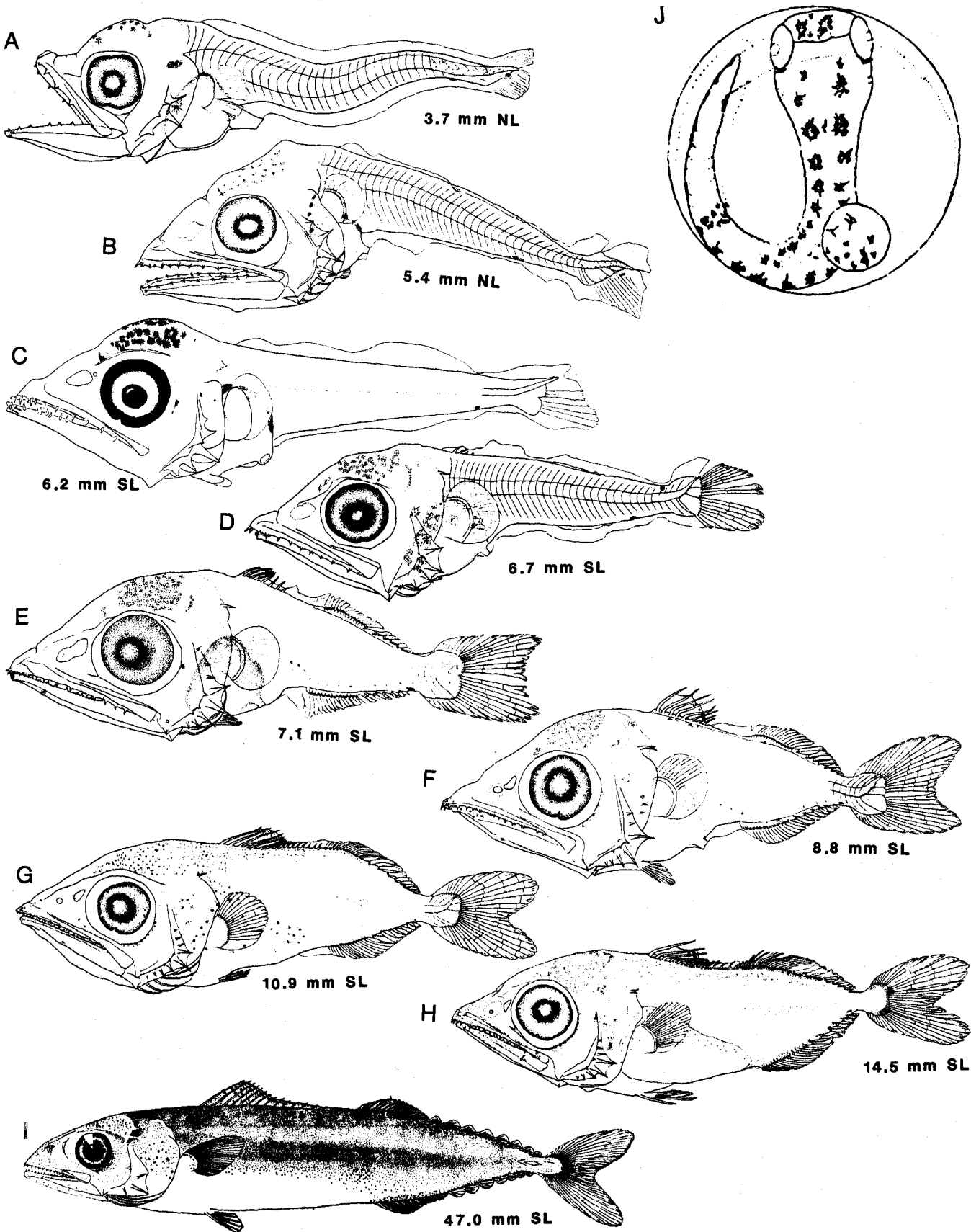
## LARVAE

Length at flexion: ca. 6 mm  
 Length at transformation  
 Sequence of fin development: caudal, first dorsal, second dorsal, anal, pectoral, pelvic  
 Pigment: present on forebrain, midbrain, hind-brain, gut, and ventral margins of tail (rarely on dorsal margin of tail)  
 Diagnostic characters: separate from Auxis, Thunnus, Katsuwonus, and Euthynnus by pigment pattern  
 Distinguish from other Scombrids by pigment pattern and myomeres

Illustrations: A-B, D-H from Matsumoto 1958; C from Collette et al. 1984; I from Matsumoto 1961; J from Mayo 1973

*Katsuwonus pelamis*

SCOMBRIDAE





## SCOMBRIDAE

Thunnus alalunga (Bonnaterre)

## MERISTICS

Vertebrae	
Precaudal	18
Caudal	21
Total	39
Number of fin spines and rays	
First Dorsal	14(11-14)
Second Dorsal	15(12-16)
Dorsal Finlets	8(7-10)
Anal	14(11-16)
Anal Finlets	7(7-10)
Pectoral	30-36
Pelvic	1,5
Caudal	
Dorsal Secondary	15-17
Principal	9+8
Ventral Secondary	15-17
Total	47-51
Gillrakers on first arch	
Upper	
Lower	
Total	25-31
Branchiostegals	
First Closed Hemal Arch on Vertebrae	10

## LIFE HISTORY

Range: off continental coast, absent from Gulf and Caribbean

Habitat: epi-, mesopelagic, oceanic

ELH pattern: oviparous, buoyant eggs, pelagic larvae

## Spawning:

Season: few larvae, in winter

Area: few larvae east of Bahamas and Lesser Antilles

Mode: batches

Migration: occurs, but not known in our area

## Fecundity

Age at first maturity

Longevity

Literature: Collette and Nauen 1983; Richards 1984

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 0.84-0.94 mm

No. of Oil Globules: one

Oil Globule Diameter: 0.24 mm

Yolk: homogenous

Shell: clear

Hatch Size: 2.60 mm NL

Incubation

Pigment

Diagnostic characters

## LARVAE

Length at flexion: ca. 6.0 mm

Length at transformation

Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral

Pigment: present on midbrain, gut, and tips of jaws >7 mm, first dorsal fin >5 mm

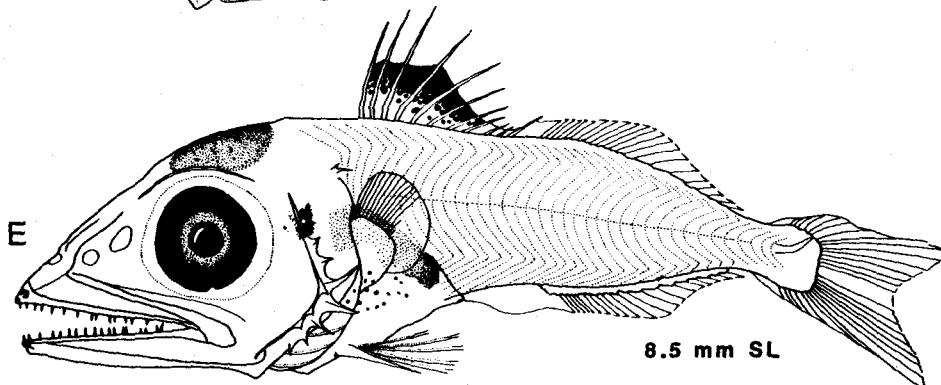
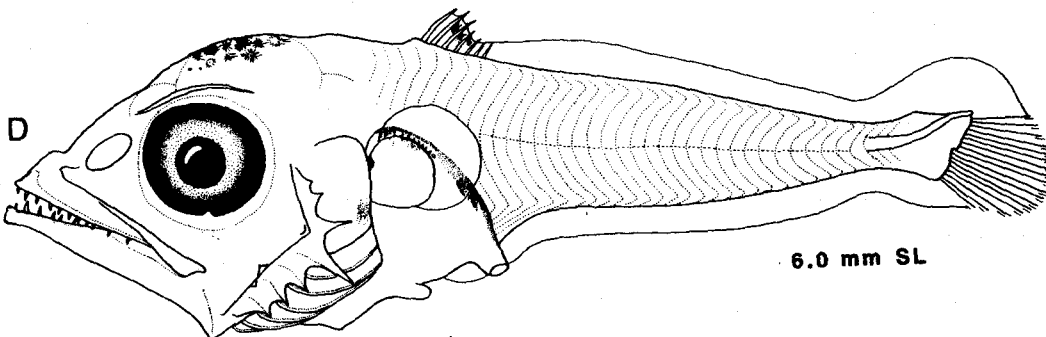
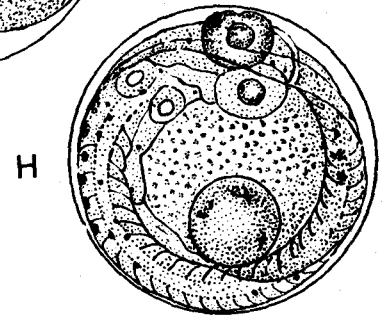
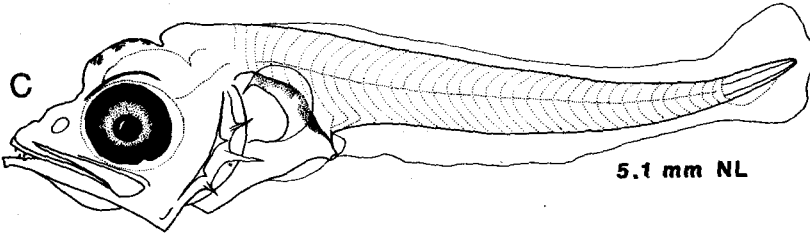
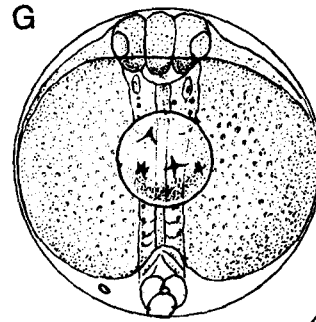
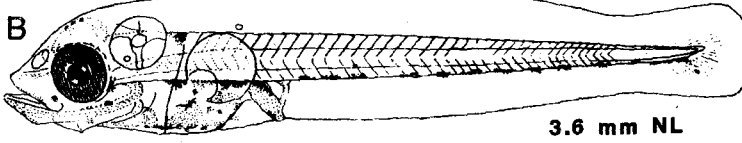
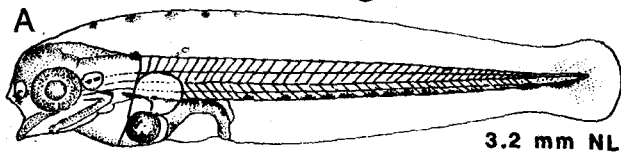
Diagnostic characters: separate from other Thunnus by pigment pattern and position of first closed hemal arch; Auxis, Katsuwonus, and Euthynnus by pigment pattern

Distinguish from other Scombrids by pigment pattern and myomeres

Illustrations: A-B, G-H from Sanzo 1933; C-E Original

*Thunnus alalunga*

SCOMBRIDAE



## SCOMBRIDAE

Thunnus albacares (Bonnaterre)

## MERISTICS

Vertebrae	
Precaudal	18
Caudal	21
Total	39
Number of fin spines and rays	
First Dorsal	14 (11-14)
Second Dorsal	15 (12-16)
Dorsal Finlets	8 (7-10)
Anal	14 (11-16)
Anal Finlets	7 (7-10)
Pectoral	30-36
Pelvic	1,5
Caudal	
Dorsal Secondary	15-17
Principal	9+8
Ventral Secondary	15-17
Total	47-51
Gillrakers on first arch	
Upper	
Lower	
Total	26-34
Branchiostegals	
First Closed Hemal Arch on Vertebrae 11	

## LIFE HISTORY

Range: throughout area  
Habitat: epipelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning:     Season: warm months  
              Area: throughout area  
              Mode:  
              Migration: occurs, but not known in our area  
Fecundity  
Age at first maturity  
Longevity

Literature: Collette and Nauen 1983; Mori et al. 1971

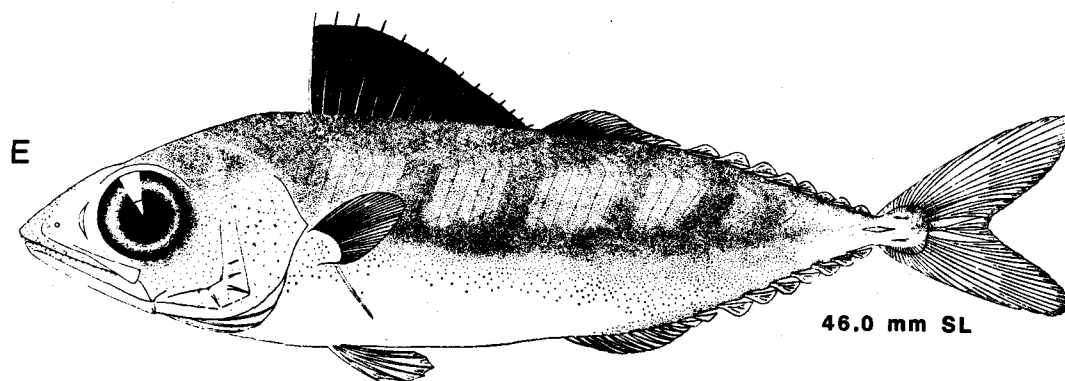
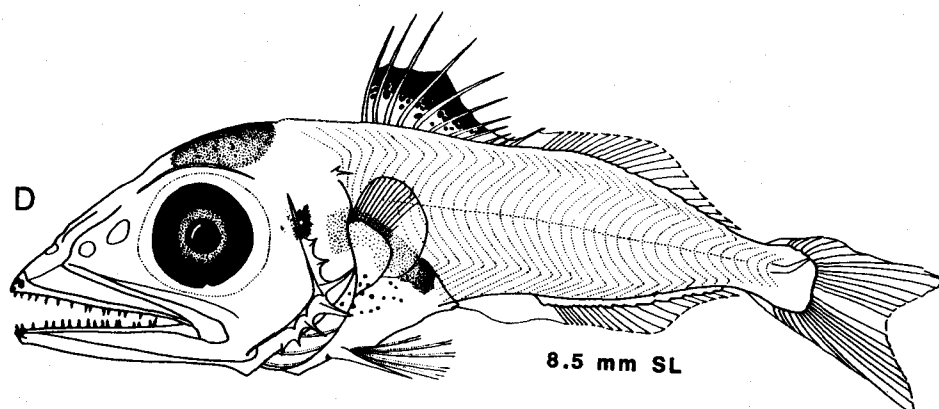
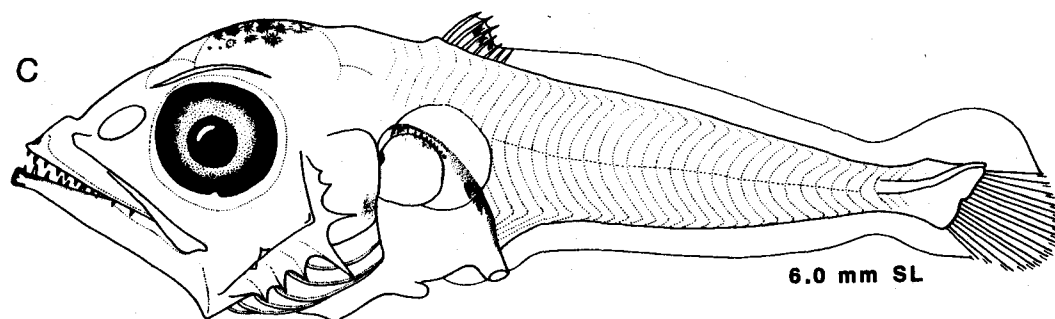
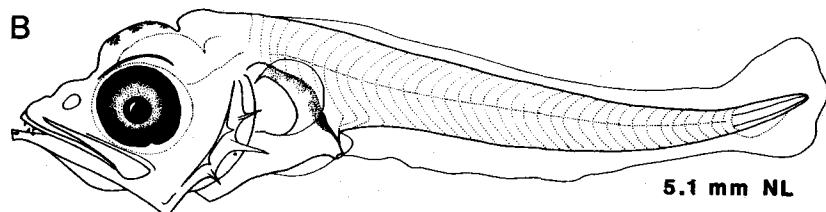
## EARLY LIFE HISTORY DESCRIPTION

EGGS: from Mori et al. 1971  
Diameter: 0.90-1.04 mm  
No. of Oil Globules: one  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size: 2.7 mm TL  
Incubation: 24-38 hrs at 26°C  
Pigment: yellow pigment in finfold and small black pigment spots persisting into larval stage  
Diagnostic characters: size and pigmentation

## LARVAE

Length at flexion: ca 6 mm  
Length at transformation  
Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral  
Pigment: present on midbrain, gut, tips of jaws, and first dorsal fin >5 mm  
Diagnostic characters: separate from other Thunnus by pigment pattern and position of first closed hemal arch; Auxis, Katsuwonus, and Euthynnus by pigment pattern  
Distinguish from other scombrids by pigment pattern and myomeres

Illustrations: B-D Original; E from Matsumoto 1961



## SCOMBRIDAE

Thunnus atlanticus (Lesson)

## MERISTICS

Vertebrae	
Precaudal	19
Caudal	20
Total	39
Number of fin spines and rays	
First Dorsal	14 (11-14)
Second Dorsal	15 (12-16)
Dorsal Finlets	8 (7-10)
Anal	14 (11-16)
Anal Finlets	7 (7-10)
Pectoral	30-36
Pelvic	1,5
Caudal	
Dorsal Secondary	15-17
Principal	9+8
Ventral Secondary	15-17
Total	47-51
Gillrakers on first arch	
Upper	
Lower	
Total	19-25
Branchiostegals	
First Closed Hemal Arch on Vertebrae 11	

## LIFE HISTORY

Range: throughout area  
Habitat: epipelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae

## Spawning:

Season: warm months  
Area: throughout area  
Mode:  
Migration:

## Fecundity

Age at first maturity

Longevity

Literature: Collette and Nauen 1983; Richards and Bullis 1978; Richards et al. 1984; Kelley et al. 1986

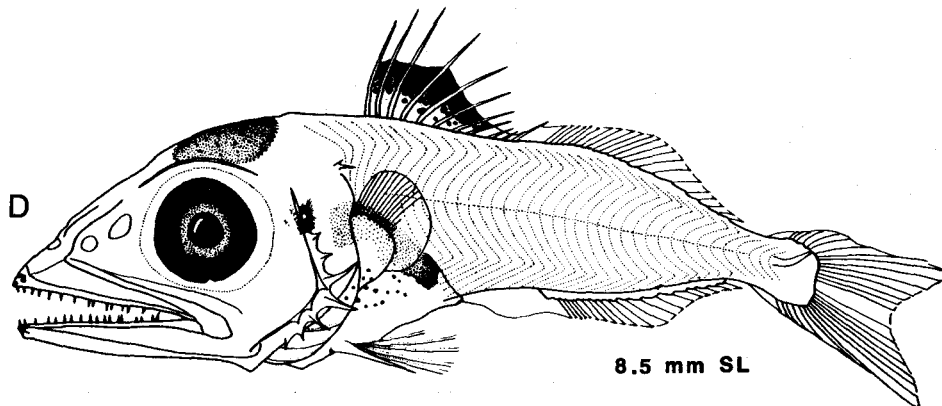
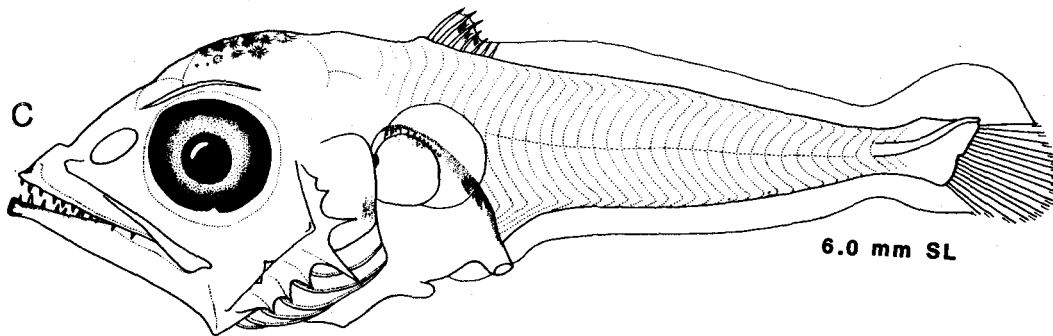
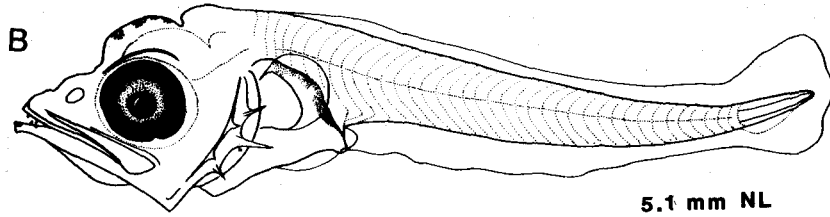
## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

## LARVAE

Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral  
Pigment: present on midbrain, gut, tips of jaws, ventral margin of tail (sometimes absent and when present pigment spots are very small), and first dorsal fin >5 mm  
Diagnostic characters: separate from other Thunnus by precaudal/caudal vertebrae, pigment pattern, and position of first closed hemal arch; Auxis, Katsuwonus, and Euthynnus by pigment pattern  
Distinguish from other Scombrids by pigment pattern and myomeres

Illustrations: B-D Original



## MERISTICS

---

Vertebrae		
Precaudal		18
Caudal		21
Total		39
Number of fin spines and rays		
First Dorsal		14 (11-14)
Second Dorsal		15 (12-16)
Dorsal Finlets		8 (7-10)
Anal		14 (11-16)
Anal Finlets		7 (7-10)
Pectoral		30-36
Pelvic		1,5
Caudal		
Dorsal Secondary		15-17
Principal		9+8
Ventral Secondary		15-17
Total		47-51
Gillrakers on first arch		
Upper		
Lower		
Total		23-31
Branchiostegals		
First Closed Hemal Arch on Vertebrae 11		

---

## LIFE HISTORY

---

Range: off continents and eastern Caribbean, but  
absent from Gulf and western Caribbean

Habitat: epi-, mesopelagic, oceanic

ELH pattern: oviparous, buoyant eggs, pelagic  
larvae

Spawning:

- Season: warm months
- Area: few confirmed larvae
- Mode:
- Migration:

Fecundity: 2.9 to 6.3 million

Age at first maturity

Longevity

---

Literature: Collette and Nauen 1983

## EARLY LIFE HISTORY DESCRIPTION

---

EGGS: unknown

Diameter

No. of Oil Globules

Oil Globule Diameter

Yolk

Shell

Hatch Size

Incubation

Pigment

Diagnostic characters

---

## LARVAE

Length at flexion: ca. 6 mm

Length at transformation

Sequence of fin development: caudal, first dorsal,  
second dorsal, anal, pelvic, pectoral

Pigment: present on midbrain, gut, tips of jaws,  
ventral margin of tail, and first dorsal  
fin >5 mm

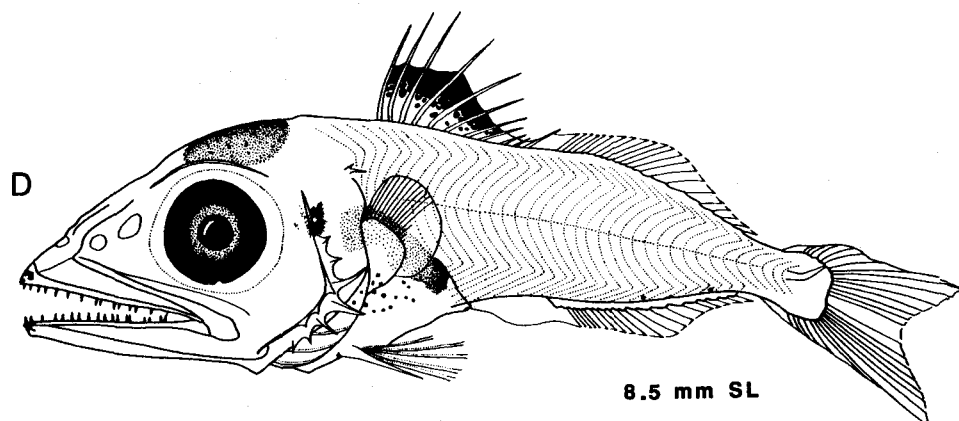
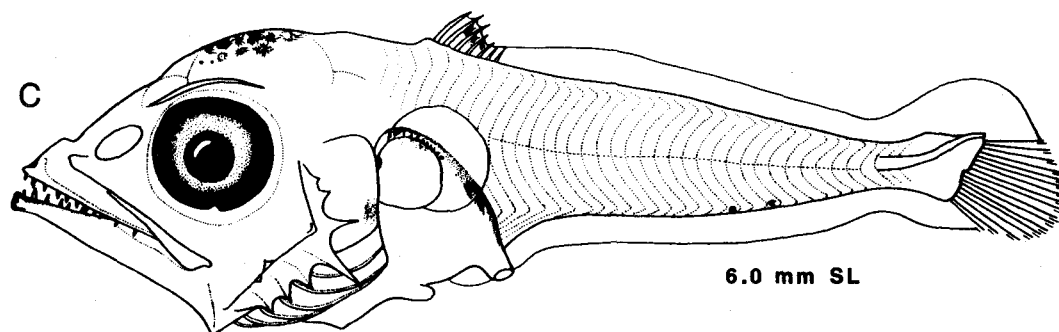
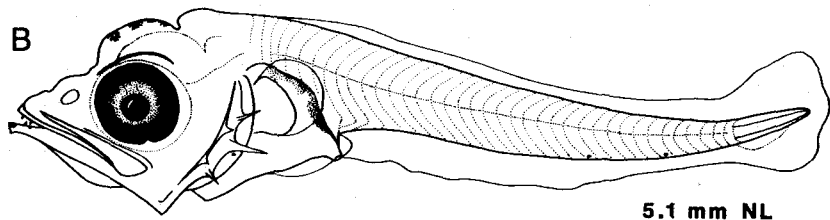
Diagnostic characters: separate from other Thunnus  
by pigment pattern, and position of  
first closed hemal arch; Auxis,  
Katsuwonus, and Euthynnus by pigment  
pattern

Distinguish from other scombrids by pigment  
pattern and myomeres

---

Illustrations: B-D Original

---





## SCOMBRIDAE

Thunnus thynnus (Linnaeus)

## MERISTICS

Vertebrae	
Precaudal	18
Caudal	21
Total	39
Number of fin spines and rays	
First Dorsal	14 (11-14)
Second Dorsal	15 (12-16)
Dorsal Finlets	8 (7-10)
Anal	14 (11-16)
Anal Finlets	7 (7-10)
Pectoral	30-36
Pelvic	1,5
Caudal	
Dorsal Secondary	15-17
Principal	9+8
Ventral Secondary	15-17
Total	47-51
Gillrakers on first arch	
Upper	
Lower	
Total	34-43
Branchiostegals	
First Closed Hemal Arch on Vertebrae	10

## LIFE HISTORY

Range: throughout area

Habitat: epi-, mesopelagic, oceanic, but seasonally close to shore

ELH pattern: oviparous, buoyant eggs, pelagic larvae

## Spawning:

Season: April 15 to June 15

Area: Gulf of Mexico and Florida Straits

Mode:

Migration: From spawning grounds north, return in winter

Fecundity: mean relative fecundity 128.5  
eggs/g/female/yr

Age at first maturity: about 7th year

Longevity: at least to 35 years

Literature: Collette and Nauen 1983; Baglin and Rivas 1977; Richards and McGowan 1986

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 1.00-1.12 mm

No. of Oil Globules: one

Oil Globule Diameter: 0.25-0.28 mm

Yolk: homogenous

Shell: clear

Hatch Size: 3.0 mm TL

Incubation

Pigment

Diagnostic characters

## LARVAE

Length at flexion: ca. 6 mm

Length at transformation

Sequence of fin development: caudal, first dorsal, second dorsal, anal, pelvic, pectoral

Pigment: present on midbrain, gut, tips of jaws, dorsal and ventral margins of tail, and first dorsal fin &gt;5 mm

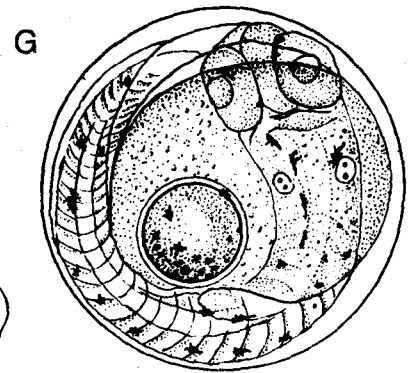
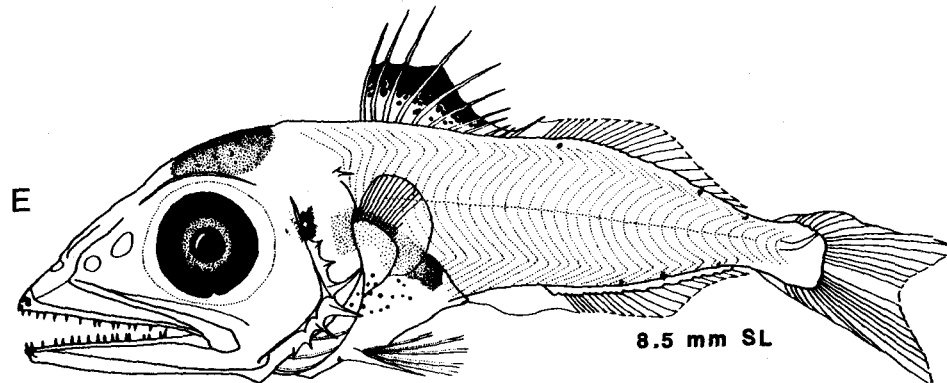
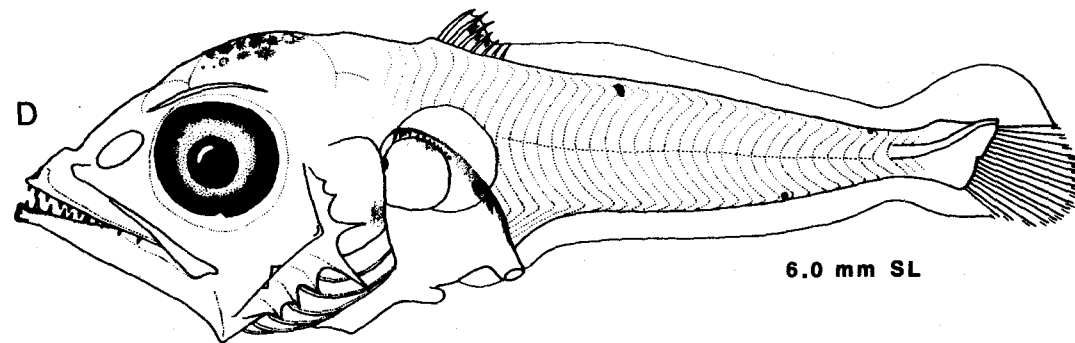
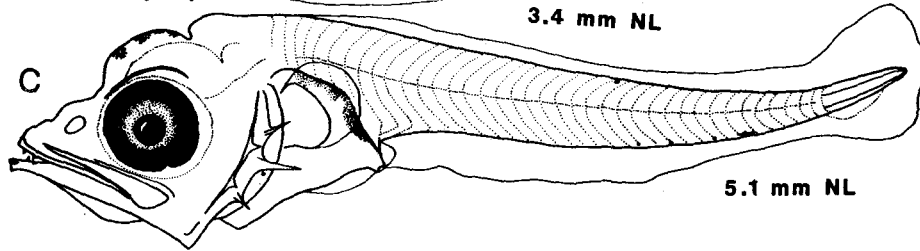
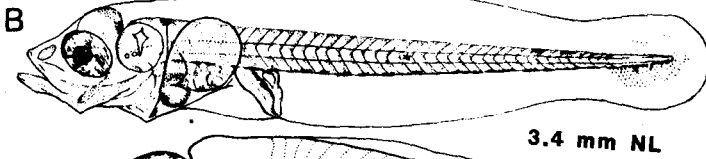
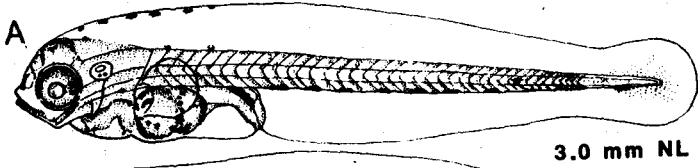
Diagnostic characters: separate from other Thunnus by pigment pattern, and position of first closed hemal arch; Auxis, Katsuwonus, and Euthynnus by pigment pattern

Distinguish from other scombrids by pigment pattern and myomeres

Illustrations: A, B, G from Sanzo 1932;  
C-E Original

*Thunnus thynnus*

SCOMBRIDAE



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## FAMILY GEMPYLIDAE

The gempylids are closely related to the trichiurids, but their ELH stages are much more common in the pelagic zones of the World's tropical seas. Consequently all the larval stages are known for the nine species from our area. Each of these species is monogeneric and quite distinctive resulting in relative ease in identifying them to species at all stages except for the eggs which are unknown. All of the species are mesopelagic as adults except for Ruvettus pretiosus which is caught in deep reef areas (>200 m) by commercial snapper fishermen. The larvae are all pelagic and I have seen all species except for Ruvettus. Much progress has been made in identifying gempylid larvae and juveniles by T. C. Potthoff (see Collette et al. 1984) and by Nishikawa (1987). The latter work was drawn on heavily for this paper. Potthoff and I had planned more extensive studies on this group utilizing the Dana material, but unfortunately previous holders of this material allowed specimens to fade thus limiting their use. Nishikawa's excellent work, though based mostly on Pacific specimens, completes any voids in the literature.

Because of their general appearance being similar to tunas and their abundance in epipelagic zones, this is an important group and their identification is important. Also because of prominent dorsal fins with high counts they have been mistaken for billfishes by unwary researchers.

## GEMPYLIDAE

Lepidocybium flavobrunneum (Smith)

## MERISTICS

Vertebrae		
Precaudal		16
Caudal		15
Total		31
Number of fin spines and rays		
First Dorsal	VIII-XII	
Second Dorsal	16-18	
Dorsal Finlets	4-6	
Total Dorsal Elements		
Anal	II, 10-14	
Anal Finlets	4-5	
Total Ventral Elements		
Pectoral	15-17	
Pelvic	I, 5	
Caudal		
Dorsal Secondary	10	
Principal	9+8	
Ventral Secondary	10	
Total	37	
Gillrakers on first arch		
Upper		
Lower		
Total	0	
Branchiostegals		

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae

## Spawning:

Season:  
Area:  
Mode:  
Migration:

## Fecundity

Age at first maturity

Longevity

## Literature:

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

## LARVAE

Length at flexion: ca. 5-6 mm NL

Length at transformation

Sequence of fin development: first dorsal, pelvic, caudal, pectoral, second dorsal, anal

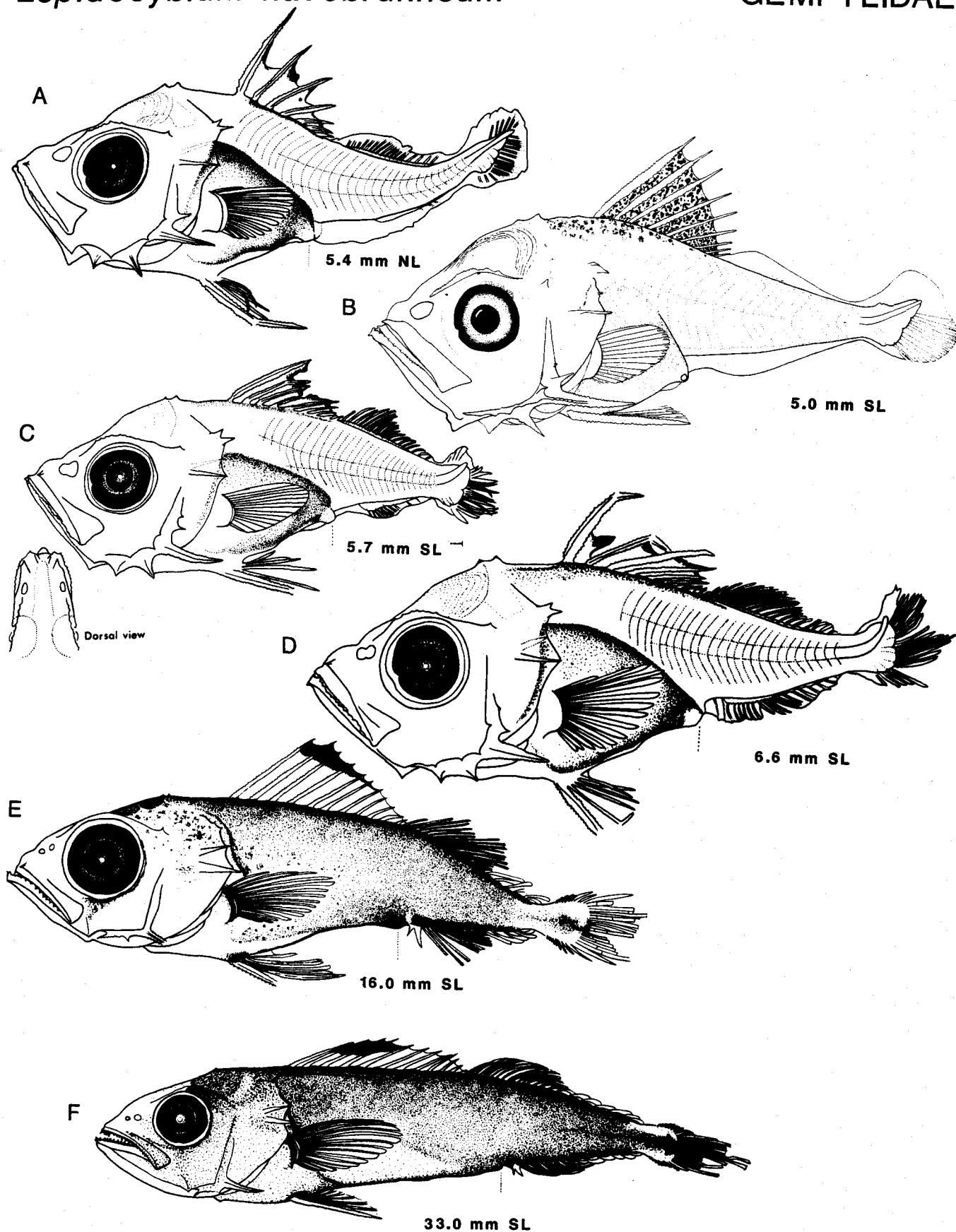
Pigment: forebrain, midbrain, over gut, nuchal area, first dorsal fin, below dorsal fin

Diagnostic characters: frontal bone layering, pigment pattern and meristics

Illustrations: A, C-F from Nishikawa 1987;  
B from Collette et al. 1984

*Lepidocybium flavobrunneum*

GEMPYLIDAE



## GEMPYLIDAE

Ruvettus pretiosus Cocco

## MERISTICS

Vertebrae	
Precaudal	16
Caudal	16
Total	32
Number of fin spines and rays	
First Dorsal	XIII-XV
Second Dorsal	15-18
Dorsal Finlets	2-3
Total Dorsal Elements	
Anal	III,12-16
Anal Finlets	2-3
Total Ventral Elements	
Pectoral	14-15
Pelvic	1,5
Caudal	
Dorsal Secondary	10
Principal	9+8
Ventral Secondary	10
Total	37
Gillrakers on first arch	
Upper	
Lower	1(6-8 large spines emerging from tooth patches)
Total	
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: demersal, deep water  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning           Season:  
                    Area:  
                    Mode:  
                    Migration:  
Fecundity  
Age at first maturity  
Longevity

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

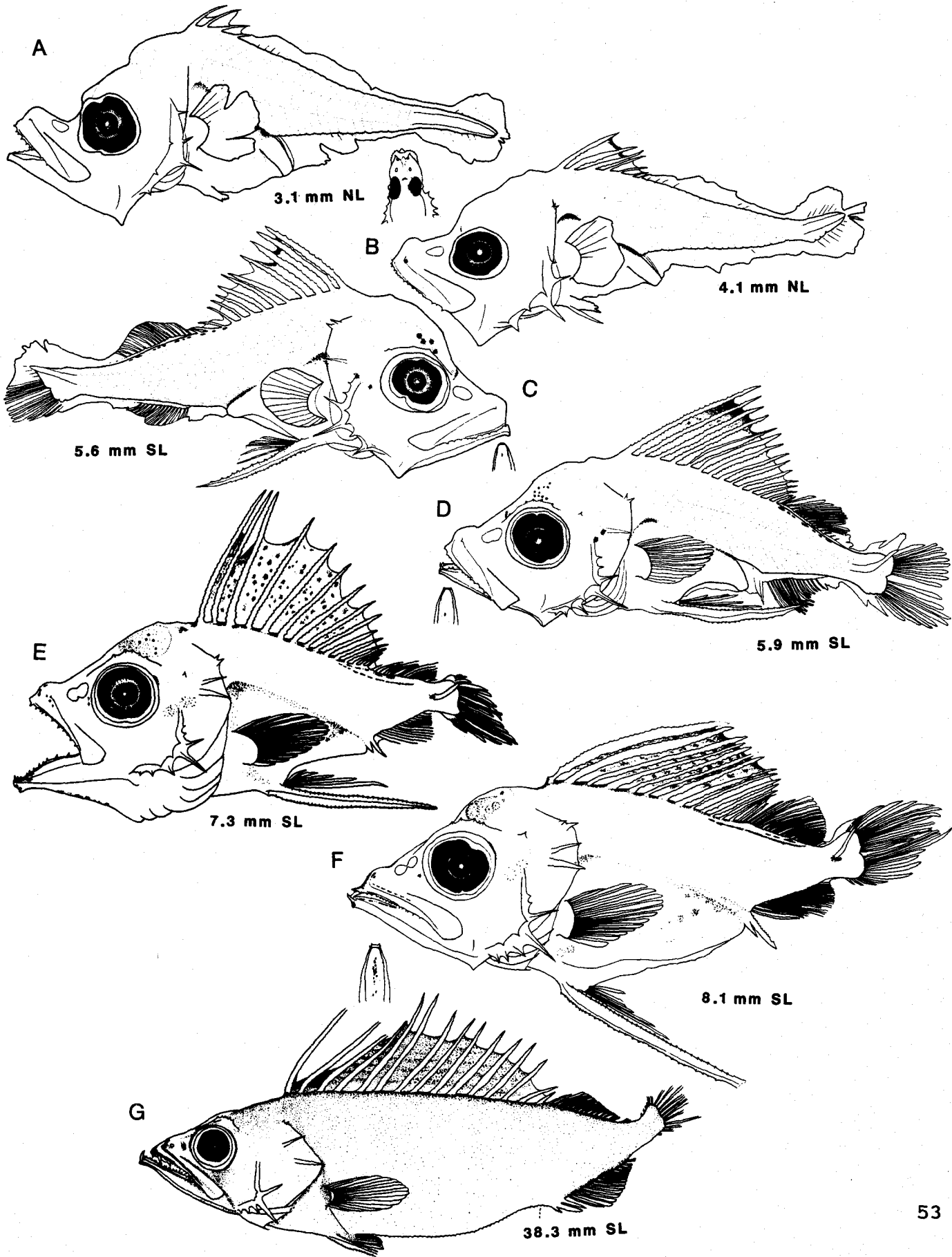
## LARVAE

Length at flexion: ca. 5-6 mm NL  
Length at transformation  
Sequence of fin development: first dorsal, caudal, pelvic, second dorsal, anal, pectoral  
Pigment: forebrain, midbrain, over gut, first dorsal fin, gular area  
Diagnostic characters: pigment pattern and meristics.

Illustrations: A-G from Nishikawa 1987

*Ruvettus pretiosus*

GEMPYLIDAE





## GEMPYLIDAE

*Epinnula magistralis* Poey

## MERISTICS

Vertebrae	
Precaudal	15
Caudal	17
Total	32
Number of fin spines and rays	
First Dorsal	XV-XVI
Second Dorsal	I,16-19
Dorsal Finlets	0
Total Dorsal Elements	
Anal	III,13-16
Anal Finlets	0
Total Ventral Elements	
Pectoral	15
Pelvic	1,5
Caudal	
Dorsal Secondary	10
Principal	9+8
Ventral Secondary	10
Total	37
Gillrakers on first arch	
Upper	
Lower	
Total	0?
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning           Season:  
                    Area:  
                    Mode:  
                    Migration:  
Fecundity  
Age at first maturity  
Longevity

Literature:

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

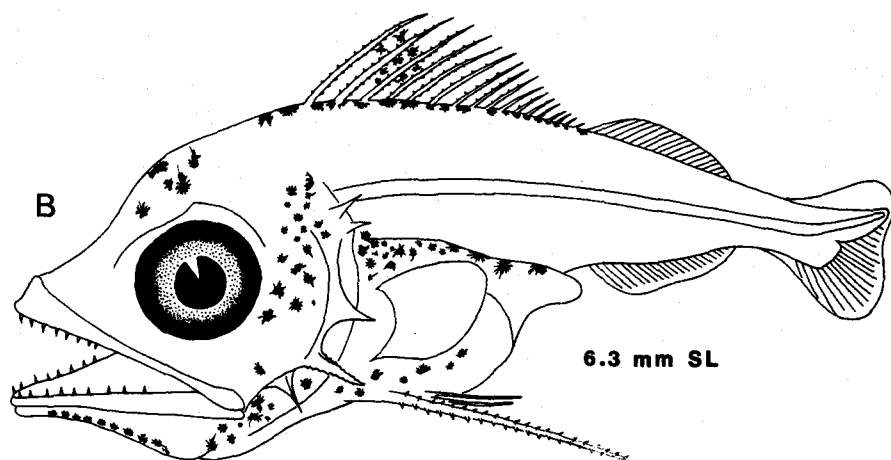
## LARVAE

Length at flexion  
Length at transformation  
Sequence of fin development: first dorsal, pelvic, caudal, second dorsal, anal, pectoral  
Pigment: forebrain, midbrain, over gut, jaw tips, first dorsal fin, gular area, behind eye, below dorsal fin  
Diagnostic characters: pigment pattern and meristics.

Illustrations: B from Collette et al. 1984

*Epinnula magistralis*

GEMPYLIDAE



## GEMPYLIDAE

*Neopinnula orientalis* (Gilchrist  
& von Bonde)

## MERISTICS

Vertebrae		
Precaudal		16
Caudal		16
Total		32
Number of fin spines and rays		
First Dorsal		XVI
Second Dorsal		I, 16-20
Dorsal Finlets		0
Total Dorsal Elements		
Anal		III, 17-20
Anal Finlets		0
Total Ventral Elements		
Pectoral		13-16
Pelvic		1, 5
Caudal		
Dorsal Secondary		9-10
Principal		9+8
Ventral Secondary		9-10
Total		35-37
Gillrakers on first arch		
Upper		
Lower		1(2-4 large teeth emerging from tooth patches)
Total		
Branchiostegals		

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae

Spawning      Season:  
                 Area:  
                 Mode:  
                 Migration:

Fecundity  
Age at first maturity  
Longevity

Literature:

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

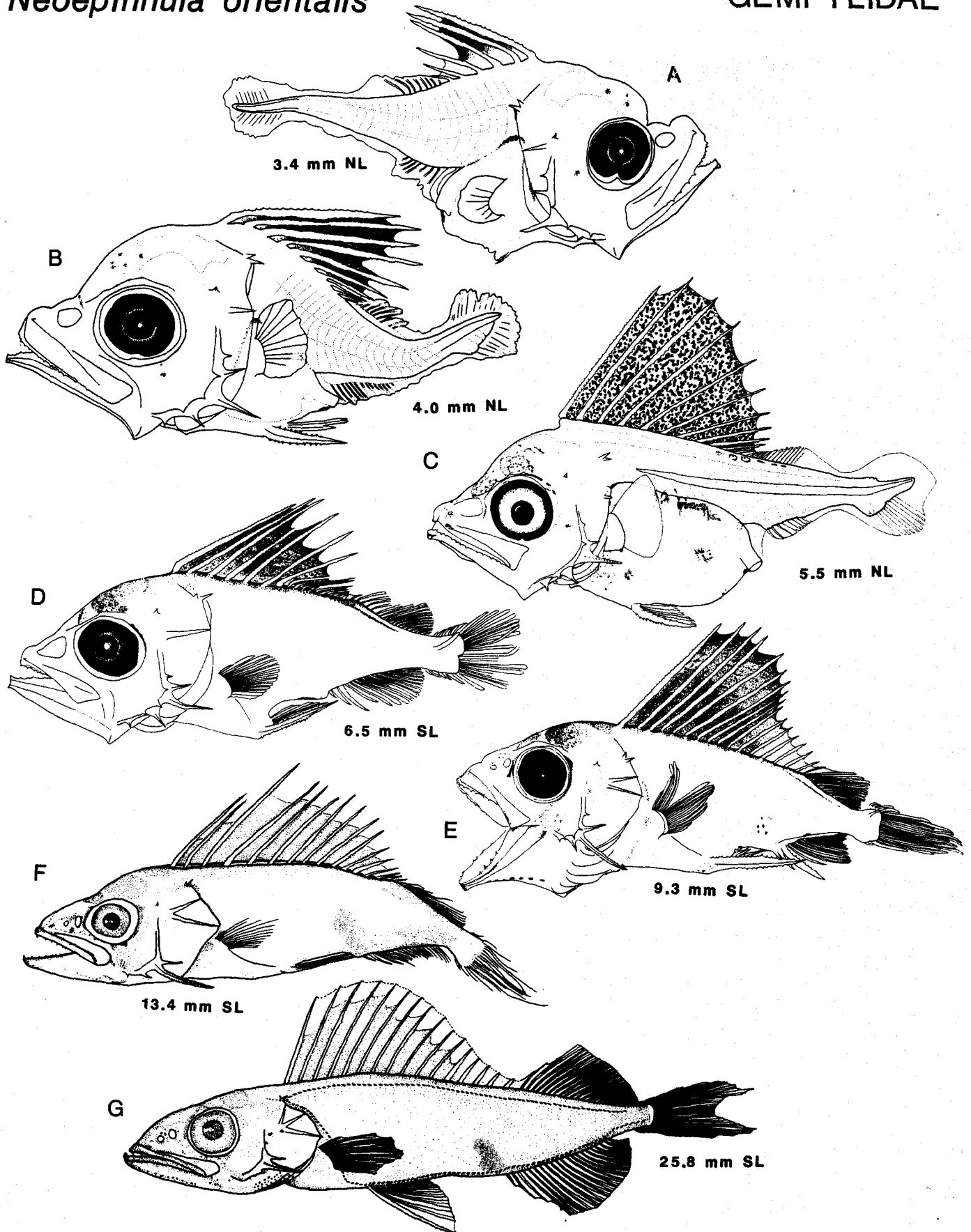
## LARVAE

Length at flexion: ca. 6-8 mm NL  
Length at transformation  
Sequence of fin development: first dorsal, pelvic,  
caudal, second dorsal, anal, pectoral  
Pigment: forebrain, midbrain, over gut, first  
dorsal fin, gular area, below dorsal fin  
Diagnostic characters: pigment pattern and  
meristics.

Illustrations: A-B, D-G from Nishikawa 1987; C  
from Collette et al. 1984

*Neopinnula orientalis*

GEMPYLIDAE



## GEMPYLIDAE

Prometichthys prometheus (Cuvier)

## MERISTICS

Vertebrae		
Precaudal		18
Caudal		16
Total		34
Number of fin spines and rays		
First Dorsal		XVII-XIX
Second Dorsal		I,17-21
Dorsal Finlets		2
Total Dorsal Elements		
Anal		I-II,15-17
Anal Finlets		2
Total Ventral Elements		
Pectoral		14
Pelvic		I,(1-2)
Caudal		
Dorsal Secondary		10-11
Principal		9+8
Ventral Secondary		10
Total		37-38
Gillrakers on first arch		
Upper		
Lower		1(10 large teeth emerging from tooth patches)
Total		
Branchiostegals		

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning            Season:  
                         Area:  
                         Mode:  
                         Migration:  
Fecundity  
Age at first maturity  
Longevity

Literature:

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

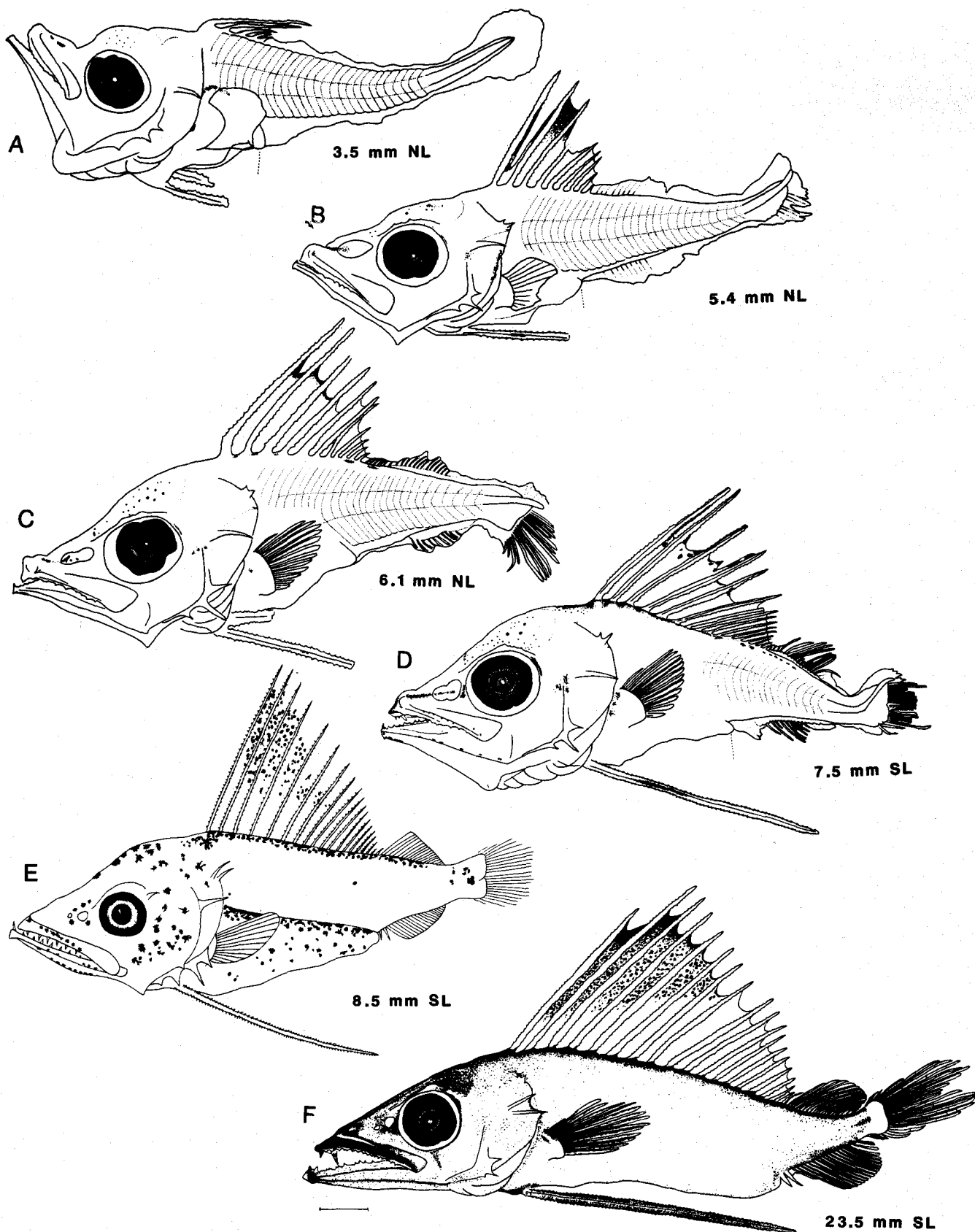
## LARVAE

Length at flexion: ca. 6-8 mm NL  
Length at transformation  
Sequence of fin development: first dorsal, pelvic, caudal, second dorsal, anal, pectoral  
Pigment: nasal area, forebrain, midbrain, over gut, first dorsal fin, jaw rami, below dorsal fin  
Diagnostic characters: pigment pattern and meristics.

Illustrations: A-D, F from Nishikawa 1987; E from Collette et al. 1984

*Prometichthys prometheus*

GEMPYLIDAE



## GEMPYLIDAE

Nesiarchus nasutus Johnson

## MERISTICS

Vertebrae	
Precaudal	20-23
Caudal	13-15
Total	33-37
Number of fin spines and rays	
First Dorsal	XIX-XXII
Second Dorsal	I, 19-22
Dorsal Finlets	2-3
Total Dorsal Elements	
Anal	II-III, 15-17
Anal Finlets	2-3
Total Ventral Elements	
Pectoral	13
Pelvic	1,5
Caudal	
Dorsal Secondary	8-9
Principal	9+8
Ventral Secondary	8-9
Total	33-35
Gillrakers on first arch	
Upper	
Lower	
Total	1
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning           Season:  
                    Area:  
                    Mode:  
                    Migration:  
Fecundity  
Age at first maturity  
Longevity

Literature:

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

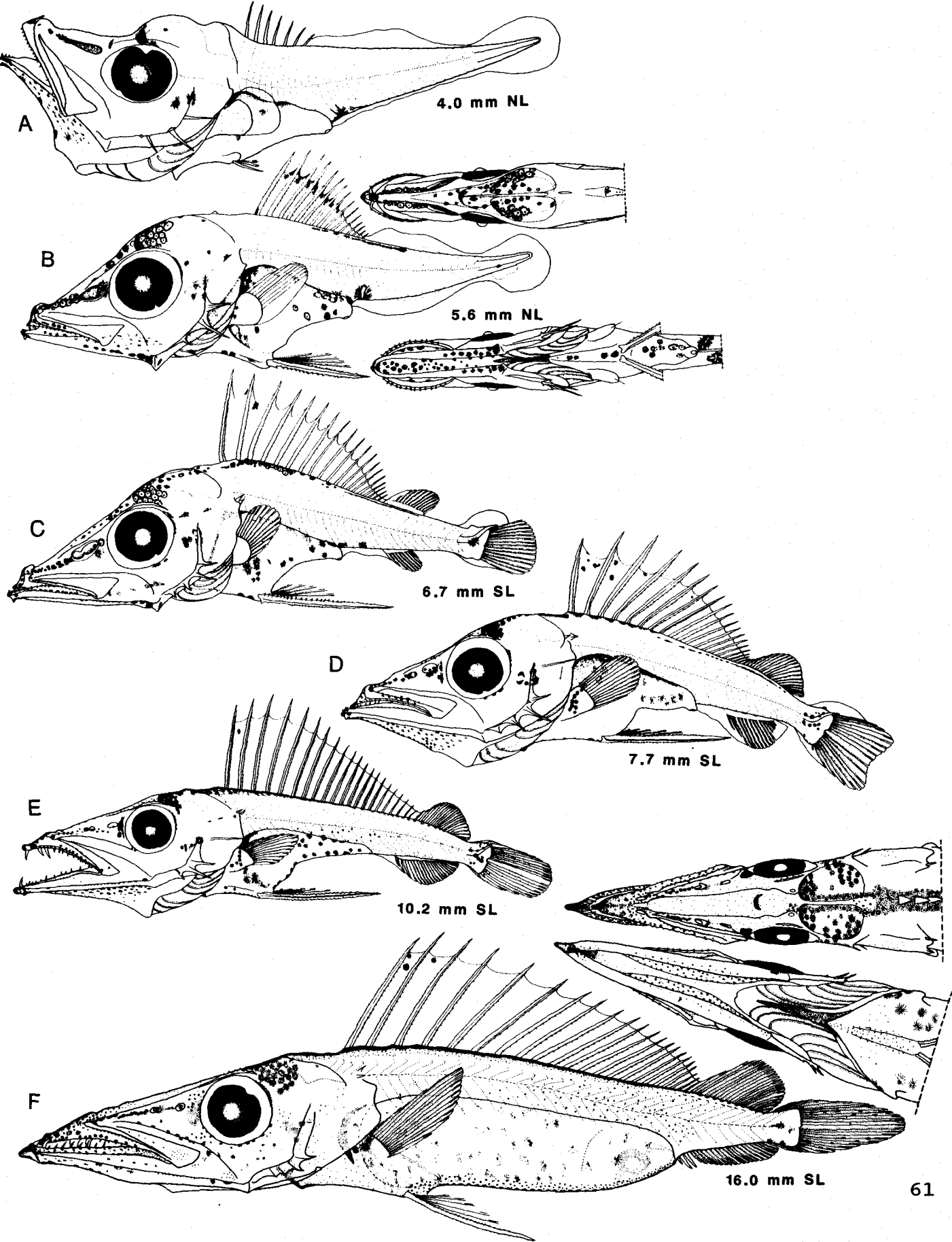
## LARVAE

Length at flexion: ca. 6 mm NL  
Length at transformation  
Sequence of fin development: first dorsal, pelvic, caudal, pectoral, second dorsal, anal  
Pigment: nasal area with prominent streak, fore-brain, midbrain, over gut, jaw tips, entire gular area, first dorsal fin, behind eye, below dorsal fin, jaw rami  
Diagnostic characters: pigment pattern (nasal streak and gular area unique) and meristics.

Illustrations: A-F original

*Nesiarchus nasutus*

GEMPYLIDAE





## GEMPYLIDAE

Nealotus tripes Johnson

## MERISTICS

Vertebrae		
Precaudal		20-22
Caudal		14-17
Total		36-39
Number of fin spines and rays		
First Dorsal		XIX-XXI
Second Dorsal		I, 16-19
Dorsal Finlets		2
Total Dorsal Elements		
Anal		II, 15-19
Anal Finlets		2
Total Ventral Elements		
Pectoral		12-14
Pelvic		I(1-2)
Caudal		
Dorsal Secondary		8
Principal		9+8
Ventral Secondary		10
Total		37-38
Gillrakers on first arch		
Upper		
Lower		1(0-5 large teeth emerging from tooth patches)
Total		
Branchiostegals		

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae

## Spawning:

Season:  
Area:  
Mode:  
Migration:

## Fecundity

Age at first maturity  
Longevity

## Literature:

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

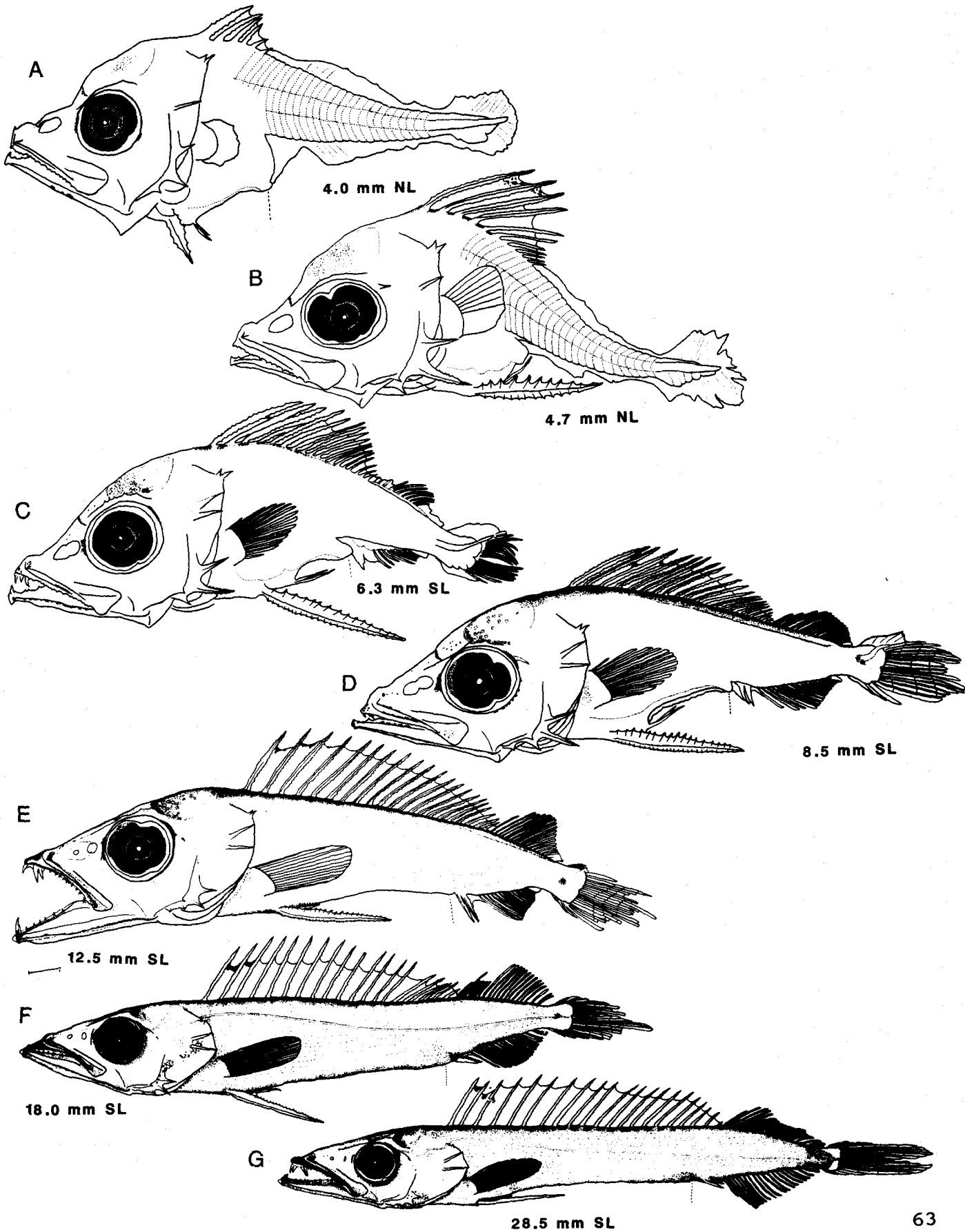
## LARVAE

Length at flexion: ca. 6 mm NL  
Length at transformation  
Sequence of fin development: first dorsal, pelvic, caudal, second dorsal, anal, pectoral  
Pigment: forebrain, midbrain, over gut, first dorsal fin, below dorsal fin  
Diagnostic characters: pigment pattern and meristics.

Illustrations: A-G from Nishikawa 1987

*Nealotus tripes*

GEMPYLIDAE



Gempylus serpens Cuvier

### EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

## LARVAE

Length at flexion: ca. 6-8 mm NL  
Length at transformation  
Sequence of fin development: first dorsal, pelvic,  
caudal, pectoral, second dorsal, anal  
Pigment: forebrain, midbrain, over gut, jaw tips,  
dorsal and ventral tail margins, lateral  
line area, first dorsal fin, before eye  
Diagnostic charaters: pigment pattern (only  
species with lateral pigment) and  
meristics.

Illustrations: A-B,D-F from Nishikawa 1987; C from Collette et al. 1984

Habitat: epi-mesopelagic, oceanic

ELH pattern: oviparous, buoyant eggs, pelagic larvae

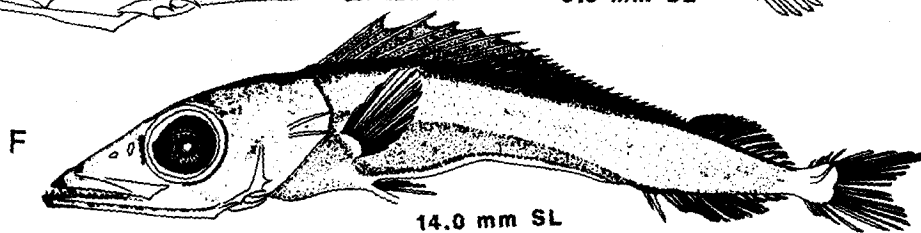
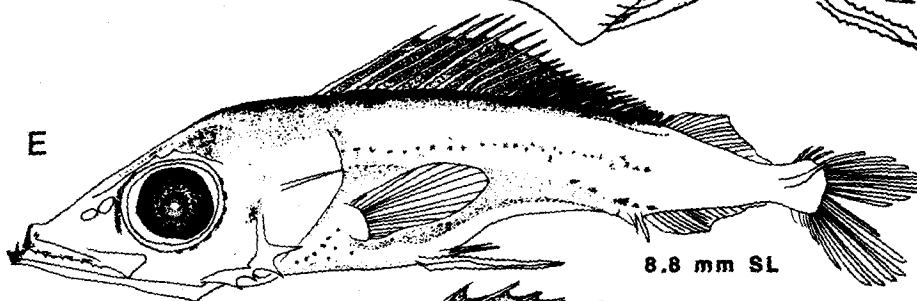
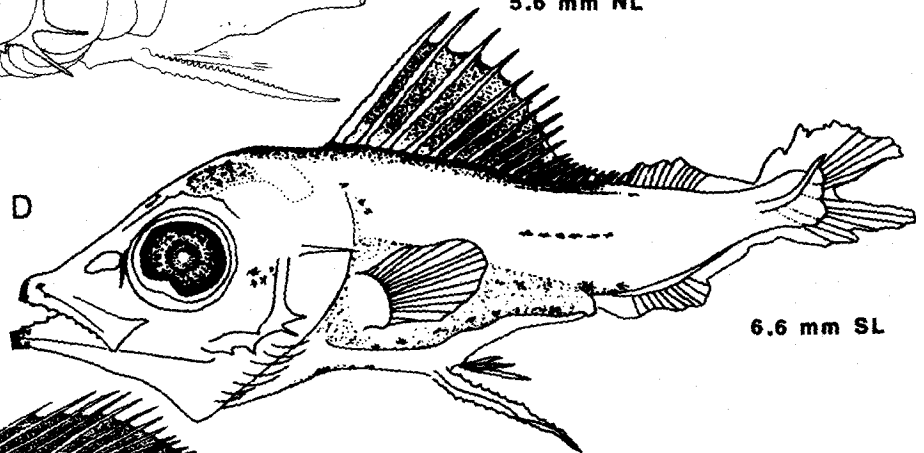
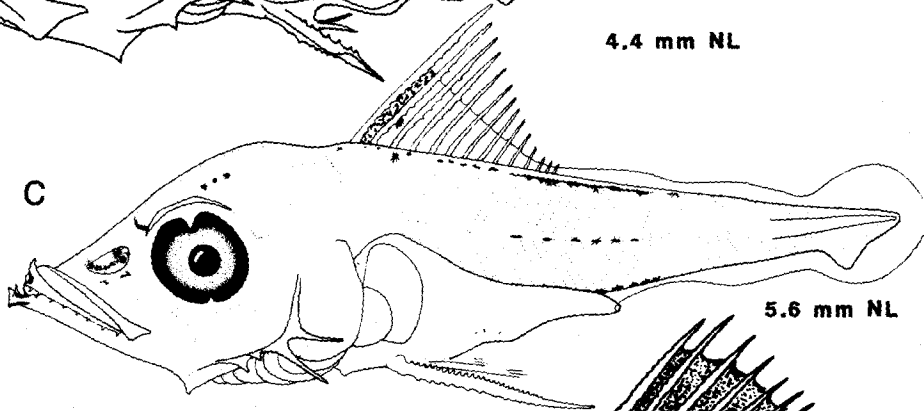
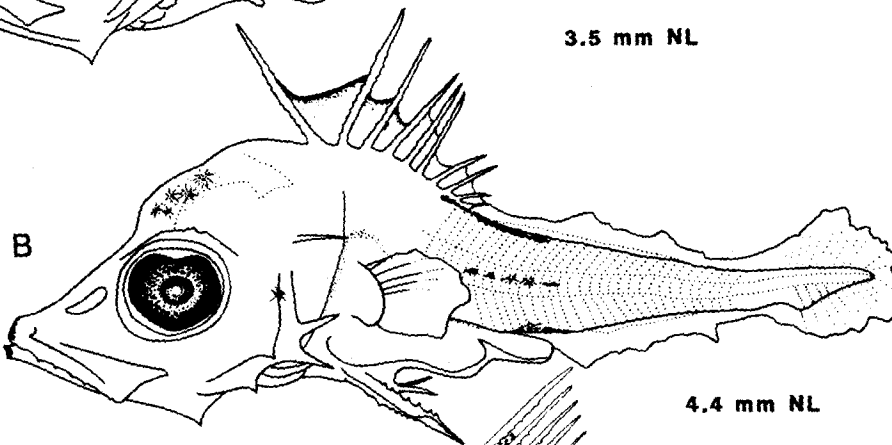
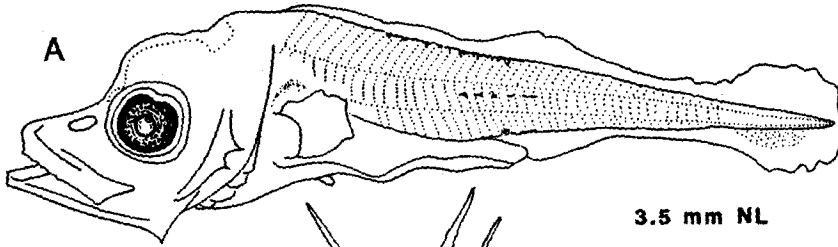
Spawning                      Season:  
   Area:  
   Mode:  
   Migration:

Fecundity  
Age at first maturity  
Longevity

**Literature:**

*Gempylus serpens*

GEMPYLIDAE



## GEMPYLIDAE

Diplospinus multistriatus Maul

## MERISTICS

Vertebrae		
Precaudal		22-28
Caudal		30-37
Total		58-61
Number of fin spines and rays		
First Dorsal		XXX-XXXVI
Second Dorsal		I,35-41
Dorsal Finlets		0
Total Dorsal Elements		
Anal		11,29-35
Anal Finlets		0
Total Ventral Elements		
Pectoral		14
Pelvic		1
Caudal		
Dorsal Secondary		4
Principal		9+8
Ventral Secondary		5
Total		26
Gillrakers on first arch		
Upper		
Lower		
Total		28
Branchiostegals		

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning                      Season:  
                                 Area:  
                                 Mode:  
                                 Migration:  
Fecundity  
Age at first maturity  
Longevity

## Literature:

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

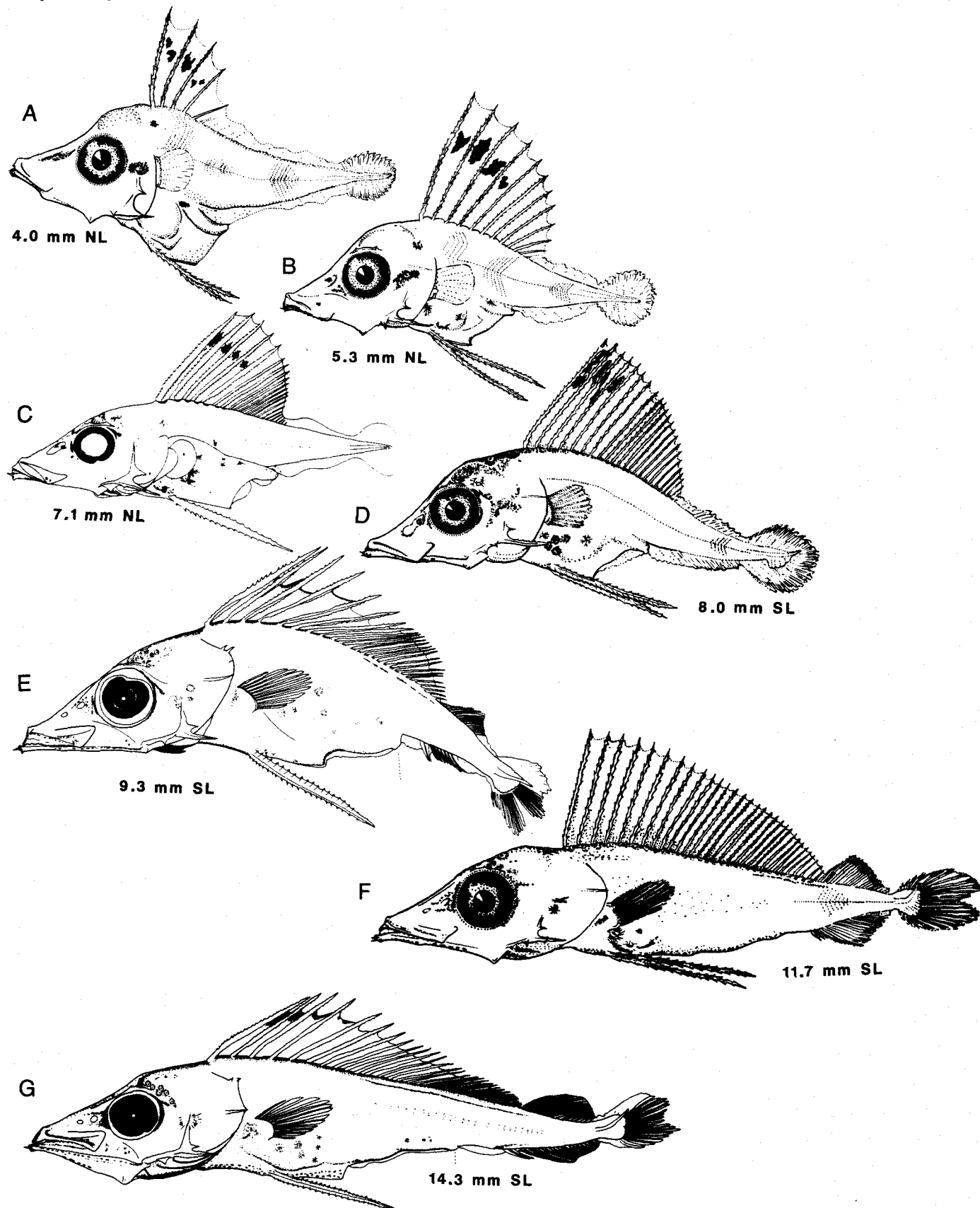
## LARVAE

Length at flexion: ca. 8 mm NL  
Length at transformation  
Sequence of fin development: first dorsal, pelvic, caudal, pectoral, second dorsal, anal  
Pigment: forebrain, midbrain, over gut, lower jaw tip, first dorsal fin, behind eye, below dorsal fin, lower jaw ramus  
Diagnostic characters: pigment pattern and meristics.

Illustrations: A-B, D, F from Voss 1954; C from Collette et al. 1984; E, G from Nishikawa 1987

*Diplospinus multistriatus*

GEMPYLIDAE



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#### FAMILY TRICHIURIDAE

This small family (seven species in our area) is mainly comprised of rare, mesopelagic species with one species occurring in coastal waters. Early life stages are only known for three species, but considering the rarity of many species more than the seven recorded from our area may eventually be found. Consequently care should be taken in identifying ELH specimens and great care should be taken that specimens be preserved and deposited in archiving institutions.

Identifications are based on meristic characters which separate all species. Little is known about them.



## TRICHIURIDAE

Trichiurus lepturus Linnaeus

## MERISTICS

Vertebrae	
Precaudal	39,40
Caudal	123-128
Total	162-168
Number of fin spines and rays	
First Dorsal	3
Second Dorsal	120-140
Dorsal Finlets	0
Anal	II,105-108
Anal Finlets	0
Pectoral	
Pelvic	Absent
Caudal	
Dorsal Secondary	
Principal	Absent
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	10-22
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: demersal, inshore  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning           Season:  
                    Area:  
                    Mode:  
                    Migration:  
Fecundity  
Age at first maturity  
Longevity

## Literature

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown

Diameter

No. of Oil Globules

Oil Globule Diameter

Yolk

Shell

Hatch Size

Incubation

Pigment

Diagnostic characters

## LARVAE

Length at flexion

Length at transformation

Sequence of fin development: first dorsal, second dorsal, anal, pectoral

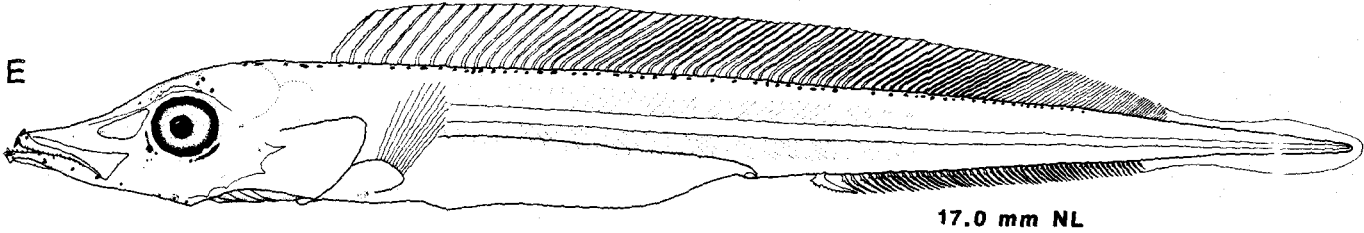
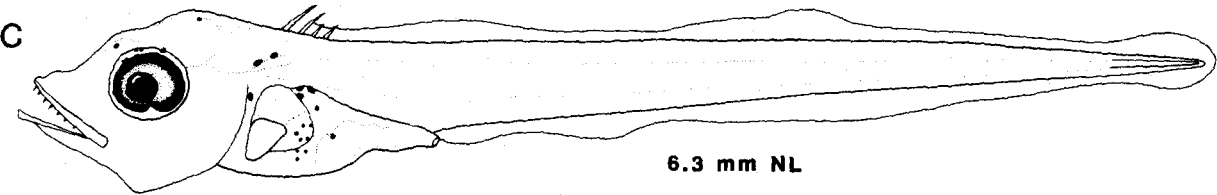
Pigment: forebrain, midbrain, over gut, under dorsal fin, and along lower jaw ramus

Diagnostic characters: pigment pattern and meristics

Illustrations: C, E from Collette et al. 1984

*Trichiurus lepturus*

TRICHIURIDAE



## TRICHIURIDAE

Lepidotus caudatus (Euphrasen)

## MERISTICS

Vertebrae	
Precaudal	41
Caudal	70-73
Total	111-114
Number of fin spines and rays	
First Dorsal	9
Second Dorsal	90-96
Dorsal Finlets	0
Total Dorsal Elements	99-105
Anal	II,61-64
Anal Finlets	0
Pectoral	
Pelvic	I,1
Caudal	
Dorsal Secondary	
Principal	Present
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: demersal, offshore  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning           Season:  
                    Area:  
                    Mode:  
                    Migration:  
Fecundity  
Age at first maturity  
Longevity

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 1.6-1.7 mm  
No. of Oil Globules: one  
Oil Globule Diameter: 0.4 mm  
Yolk: homogenous  
Shell: clear  
Hatch Size: ca. 6 mm  
Incubation: probably 7-8 days  
Pigment: large blotches on trunk and tail, pigment on oil globule  
Diagnostic characters: pigment pattern and myomere number

## LARVAE

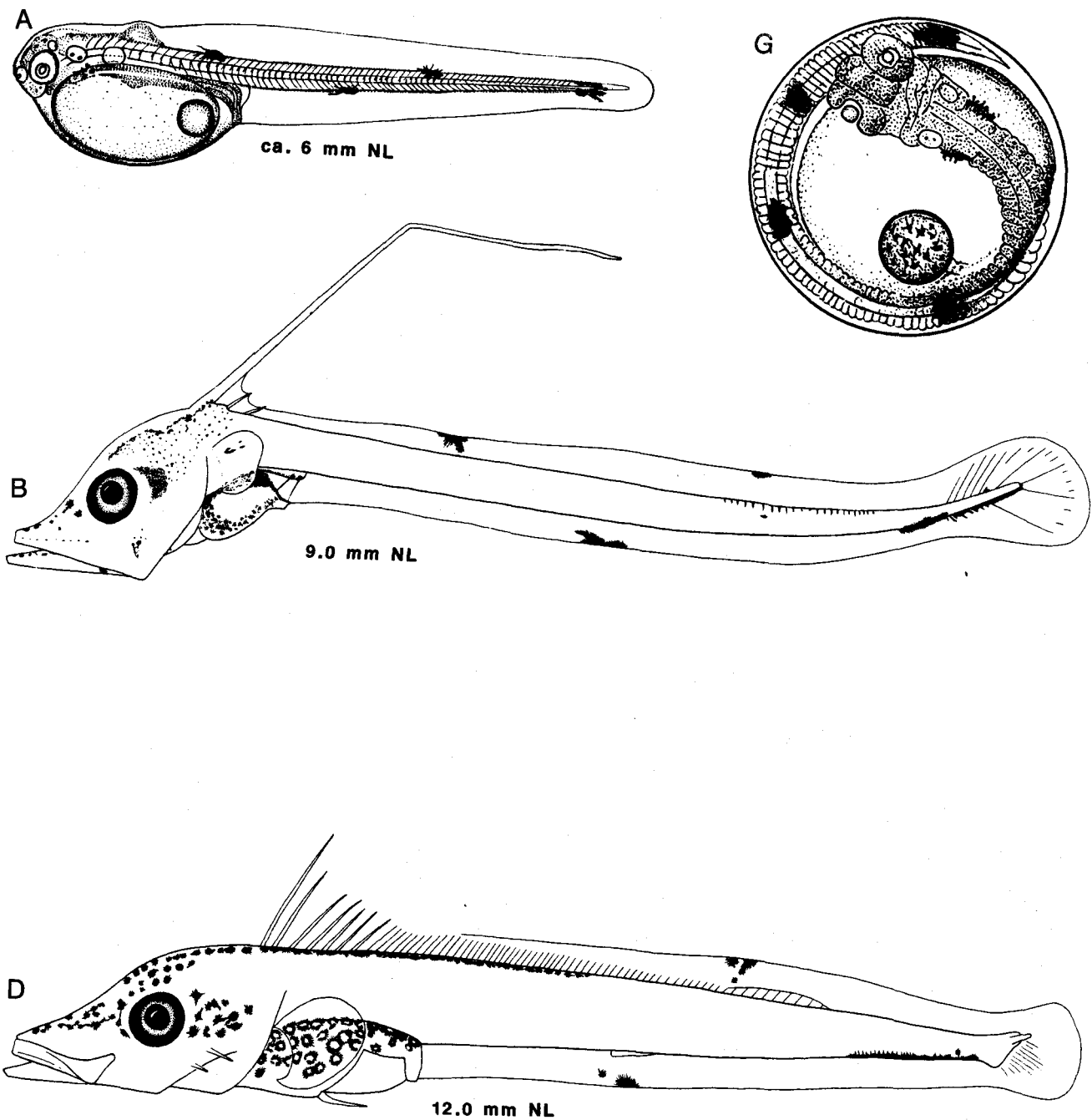
Length at flexion  
Length at transformation  
Sequence of fin development: first dorsal, second dorsal, anal, pelvic, pectoral  
Pigment: forebrain, midbrain, over gut, large blotches in small larvae which are replaced by pigment under dorsal fin and above anal fin  
Diagnostic characters: pigment pattern, meristics, high first dorsal spine which is probably temporary larval structure

Illustrations: A, G from Raffaele 1888; B, D from Collette et al. 1984

## Literature

*Lepidotus caudatus*

TRICHIURIDAE



## TRICHIURIDAE

Benthodesmus tenuis (Guenther)

## MERISTICS

## Vertebrae

Precaudal

Caudal

Total 121-131

## Number of fin spines and rays

First Dorsal 39-42

(40-42 Gulf)

Second Dorsal 79-88

(83-87 Gulf)

Dorsal Finlets 0

Total Dorsal Elements 119-129

(125-129 Gulf)

Anal 11,69-75

Anal Finlets 0

Pectoral 12-13

Pelvic 1,1 (inserted  
under or before pectoral base)

## Caudal

Dorsal Secondary 5

Principal 9+8

Ventral Secondary 5

Total 27

## Gillrakers on first arch

Upper

Lower

Total 10-16

## Branchiostegals

## LIFE HISTORY

Range: throughout area

Habitat: demersal, offshore

ELH pattern: oviparous, buoyant eggs, pelagic  
larvae

Spawning

Season:

Area:

Mode:

Migration:

Fecundity

Age at first maturity

Longevity

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown

Diameter

No. of Oil Globules

Oil Globule Diameter

Yolk

Shell

Hatch Size

Incubation

Pigment

Diagnostic characters

## LARVAE

Length at flexion

Length at transformation

Sequence of fin development: first dorsal, second  
dorsal, anal, pelvic, pectoralPigment: forebrain, midbrain, over gut, below  
dorsal fin; large blotch on ventral  
margin of tail

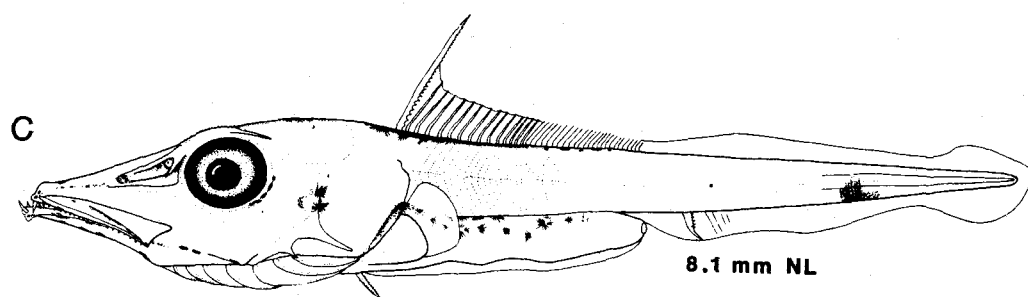
Diagnostic characters: Pigment pattern, meristics

Illustrations: C from Collette et al. 1984

## Literature

*Benthodesmus tenuis*

TRICHIURIDAE



## TRICHIURIDAE

Benthodesmus simonyi (Steindachner)

## MERISTICS

## Vertebrae

Precaudal	
Caudal	
Total	153-158

## Number of fin spines and rays

First Dorsal	44-46
Second Dorsal	104-110
Dorsal Finlets	0
Total Dorsal Elements	148-155
Anal	11,93-101
Anal Finlets	0
Pectoral	12-13
Pelvic	1,1 (inserted behind Pectoral base)

## Caudal

Dorsal Secondary	5
Principal	9+8
Ventral Secondary	5
Total	27

## Gillrakers on first arch

Upper	
Lower	
Total	10-16

## Branchiostegals

## LIFE HISTORY

Range: throughout area

Habitat: demersal, offshore

ELH pattern: probably oviparous, buoyant eggs,  
pelagic larvae

## Spawning

Season:

Area:

Mode:

Migration:

Fecundity

Age at first maturity

Longevity

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown

Diameter

No. of Oil Globules

Oil Globule Diameter

Yolk

Shell

Hatch Size

Incubation

Pigment

Diagnostic characters

LARVAE: unknown

Length at flexion

Length at transformation

Sequence of fin development

Pigment

Diagnostic

Illustrations:

## Literature

*Benthodesmus simonyi*

TRICHIURIDAE



## TRICHIURIDAE

Evoxymetopon taeniatum (Poey)

## MERISTICS

---

Vertebrae		
Precaudal		39,40
Caudal		63-65
Total		103-104
Number of fin spines and rays		
First Dorsal		10
Second Dorsal		77-86
Dorsal Finlets		0
Total Dorsal Elements		
Anal		11,56
Anal Finlets		0
Pectoral		11-12
Pelvic		1,(1-3)
Caudal		
Dorsal Secondary		7
Principal		9+8
Ventral Secondary		6-7
Total		30-31
Gillrakers on first arch		
Upper		
Lower		
Total		15-18
Branchiostegals		

---

## LIFE HISTORY

---

Range: throughout area  
 Habitat: mesopelagic, oceanic  
 ELH pattern: probably oviparous, buoyant eggs,  
                     pelagic larvae  
 Spawning           Season:  
                     Area:  
                     Mode:  
                     Migration:  
 Fecundity  
 Age at first maturity  
 Longevity

---

## Literature

## EARLY LIFE HISTORY DESCRIPTION

---

EGGS: unknown  
 Diameter  
 No. of Oil Globules  
 Oil Globule Diameter  
 Yolk  
 Shell  
 Hatch Size  
 Incubation  
 Pigment  
 Diagnostic characters

---

LARVAE: unknown  
 Length at flexion  
 Length at transformation  
 Sequence of fin development  
 Pigment  
 Diagnostic characters

---

## Illustrations:

*Evoxymetopon taeniatus*

TRICHIURIDAE

## TRICHIURIDAE

Aphanopus carbo Lowe

## MERISTICS

Vertebrae	
Precaudal	42-44
Caudal	55-56
Total	98-99
Number of fin spines and rays	
First Dorsal	38-41
Second Dorsal	11,53-57
Dorsal Finlets	0
Total Dorsal Elements	
Anal	11,44-50
Anal Finlets	0
Pectoral	12
Pelvic	I,1
	(juvenile)
Caudal	
Dorsal Secondary	
Principal	Present
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: probably oviparous, buoyant eggs,  
                  pelagic larvae  
Spawning           Season:  
                    Area:  
                    Mode:  
                    Migration:  
Fecundity  
Age at first maturity  
Longevity

## Literature

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

LARVAE: unknown  
Length at flexion  
Length at transformation  
Sequence of fin development  
Pigment  
Diagnostic characters

## Illustrations:

*Aphanopus carbo*

TRICHIURIDAE

## TRICHIURIDAE

Assurger anzac (Alexander)

## MERISTICS

Vertebrae	
Precaudal	43
Caudal	86
Total	129
Number of fin spines and rays	
First Dorsal	
Second Dorsal	
Dorsal Finlets	0
Total Dorsal Elements	122
Anal	11,80
Anal Finlets	0
Pectoral	12
Pelvic	1
Caudal	
Dorsal Secondary	
Principal	Present
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: mesopelagic, oceanic  
ELH pattern: probably oviparous, buoyant eggs,  
                    pelagic larvae  
Spawning               Season:  
                          Area:  
                          Mode:  
                          Migration:  
Fecundity  
Age at first maturity  
Longevity

## Literature

## EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment  
Diagnostic characters

LARVAE: unknown  
Length at flexion  
Length at transformation  
Sequence of fin development  
Pigment  
Diagnostic characters

## Illustrations:

*Assurger anzac*

TRICHIURIDAE

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## FAMILY ISTIOPHORIDAE

Four species in three genera comprise the family in our area. They are Istiophorus platypterus, Tetrapturus albidus, T. pfluegeri and Makaira nigricans. In the eastern Atlantic two additional species are known (T. belone and T. georgei) and M. indica has been recorded from the South Atlantic. Because these fish are known to migrate great distances these other species may occur in our area. However, I only treat the four species known to occur.

The identification of the larvae and juveniles is extremely difficult. I discussed these problems in my 1974 paper and have not made any further progress except to amass a lot more specimens. According to C. R. Robins (pers. commun.) the Atlantic species of Tetrapturus are closely related, thus the separation of larvae of the Pacific species is easier because those species are not as closely related to one another. I have seen only one specimen of T. pfluegeri and it had the characteristic branchiostegal pigment seen in Pacific spearfish. The difficult separation problem is between I. platypterus and T. albidus. I have examined hundreds of larvae and have found no character that clearly separates the larvae with pigmented lower jaw rami. Ueyanagi (1964) uses the relative position of the tip of the snout to separate the Pacific T. audax from I. platypterus, but I have found no other character to verify this. It is a difficult character to use because specimens are often bent and twisted with jaws agape from capture and preservation. M. nigricans have short snouts and pigment confined to the tip of the lower jaw which is helpful even with very small specimens > 3 mm NL. The anterior projection of the orbital rim is of less help. Great caution and care must be used in attempting to identify the larvae. The juveniles are very rare in collections. Juvenile Makaira have very short snouts whereas the others are quite elongated. De Sylva (1963) described a juvenile T. albidus with four distinct ocelli in the dorsal fin, but this specimen is unique. Juvenile I. platypterus do not have these ocelli. Adult T. pfluegeri have the anus well in advance of the anal fin origin whereas the others have the anus close to the anal fin. This character may be helpful in identifying juveniles. Except for precaudal/caudal vertebral differences, meristics are of limited help because of overlap.



# ISTIOPHORIDAE

## MERISTICS

Vertebrae	
Precaudal	12
Caudal	12
Total	24
Number of fin spines and rays	
First Dorsal	42-47
Second Dorsal	6-7
Dorsal Finlets	0
Anal	11-15
Second Anal	6-7
Anal Finlets	0
Pectoral	17-20
Pelvic	3
Caudal	
Dorsal Secondary	11-12
Principal	9+8
Ventral Secondary	11-12
Total	39-41
Gillrakers on first arch	
Upper	
Lower	
Total	Tooth patches
Branchiostegals	

## LIFE HISTORY

Range: throughout area  
Habitat: epipelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning           Season: warm months  
                    Area: throughout area  
                    Mode: paired or several males with one female  
                    Migration: long-range  
Fecundity: 0.75-19 million ova, increase with size  
Age at first maturity  
Longevity: 11 years<sup>+</sup> (E. Scott, pers. commun.)

Literature: Beardsley et al. 1975

# Istiophorus platypterus (Shaw & Nodder)

## EARLY LIFE HISTORY DESCRIPTION

EGGS  
Diameter: 1.304 mm  
No. of Oil Globules: one  
Oil Globule Diameter  
Yolk: homogenous  
Shell: clear  
Hatch Size  
Incubation  
Pigment

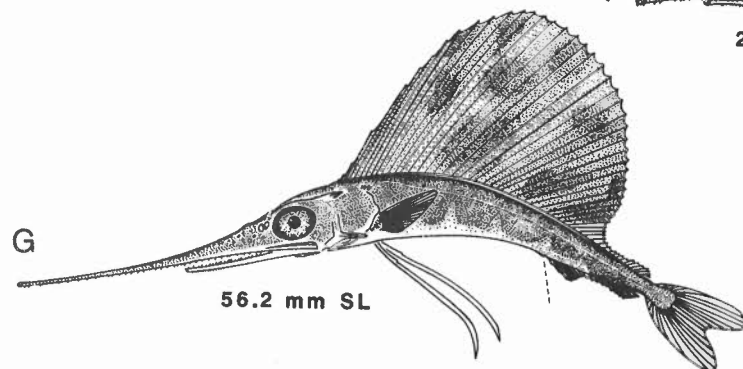
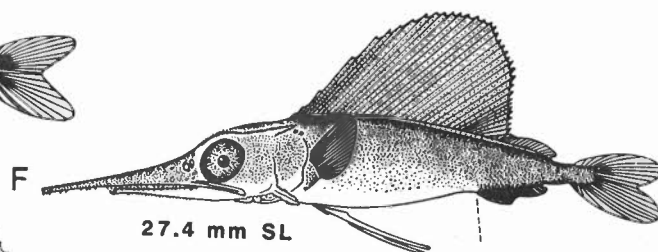
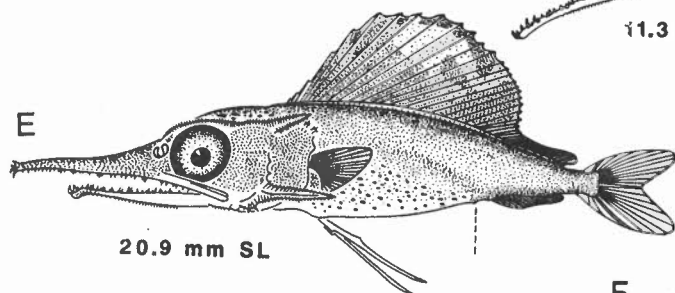
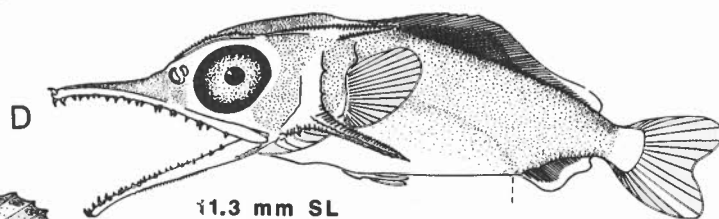
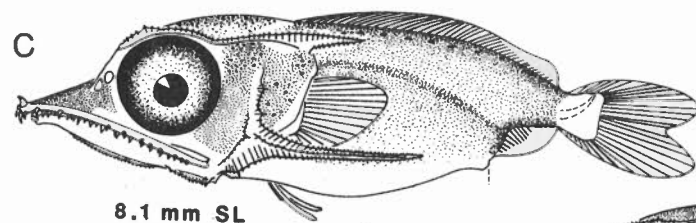
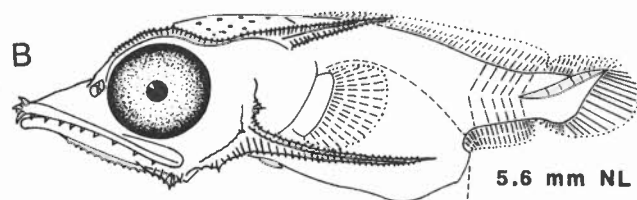
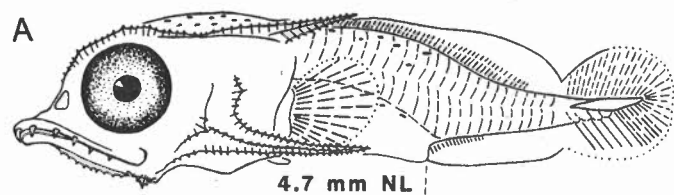
Diagnostic characters

LARVAE  
Length at flexion: ca. 6 mm  
Length at transformation  
Sequence of fin development: caudal, dorsal, anal, pectoral, pelvic  
Pigment: heavily pigmented on head and body, pigment on ramus of lower jaws and along gular area, absent from branchiostegals  
Diagnostic: from Makaira by precaudal/caudal number, long snout, and pigment pattern; from other istiophorids by pigment pattern and from I. albidus by tip of snout below hypothetical line drawn through eye, but separation is not confirmed

Illustrations: A-G from Gehringer 1956; H from Gehringer 1970

*Istiophorus platypterus*

ISTIOPHORIDAE



ISTIOPHORIDAE

Tetrapterus albidus Poey

MERISTICS

Vertebrae	
Precaudal	12
Caudal	12
Total	24
Number of fin spines and rays	
First Dorsal	38-46
Second Dorsal	5-6
Dorsal Finlets	0
Anal	12-17
Second Anal	5-6
Anal Finlets	0
Pectoral	18-21
Pelvic	3
Caudal	
Dorsal Secondary	
Principal	9+8
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	Absent
Branchiostegals	

LIFE HISTORY

Range: throughout area  
Habitat: epipelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning           Season: warm months  
                    Area: Gulf of Mexico, Florida Straits  
                    Mode: paired  
                    Migration: along U.S. east coast, Gulf to southern Caribbean  
Fecundity  
Age at first maturity: 130 cm FL  
Longevity: 12 years ( E. Scott, pers. commun.)

Literature: Mather et al. 1975

EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment

Diagnostic characters

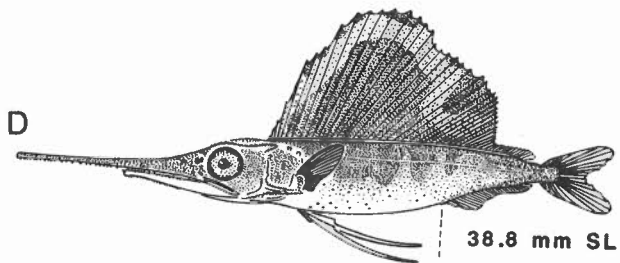
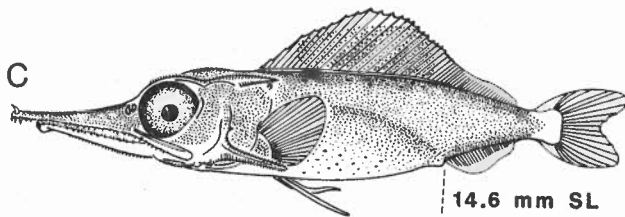
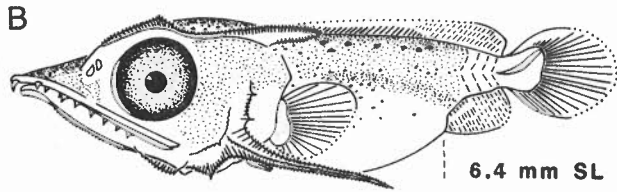
LARVAE

Length at flexion  
Length at transformation  
Sequence of fin development  
Pigment: heavily pigmented on head and body with few pigment spots probably many on lower jaw ramus and gular area, probably none on branchiostegals  
Diagnostic: from Makaira by precaudal/caudal number, pigment on lower jaw, and from other istiophorids by lack of pigment on branchiostegals and by long snout aligned above hypothetical line drawn through eye. This species cannot be reliably separated from I. platypterus

Illustrations: B-D from Gehringer 1956; E from de Sylva 1963

*Tetrapturus albidus*

ISTIOPHORIDAE



ISTIOPHORIDAE

Tetrapterus pfluegeri Robins & de Sylva

MERISTICS

Vertebrae	
Precaudal	12
Caudal	12
Total	24
Number of fin spines and rays	
First Dorsal	44-50
Second Dorsal	6-7
Dorsal Finlets	0
Anal	13-17
Second Anal	6-7
Anal Finlets	0
Pectoral	17-21
Pelvic	3
Caudal	
Dorsal Secondary	
Principal	9+8
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	Absent
Branchiostegals	

LIFE HISTORY

Range: throughout area  
 Habitat: epipelagic, oceanic  
 ELH pattern: oviparous, buoyant eggs, pelagic larvae  
 Spawning           Season: winter  
                     Area: Caribbean  
                     Mode:  
                     Migration:  
 Fecundity  
 Age at first maturity  
 Longevity

Literature: Richards 1984; Robins 1975

EARLY LIFE HISTORY DESCRIPTION

EGGS

Diameter  
 No. of Oil Globules  
 Oil Globule Diameter  
 Yolk  
 Shell  
 Hatch Size  
 Incubation  
 Pigment

Diagnostic characters

LARVAE

Length at flexion  
 Length at transformation  
 Sequence of fin development  
 Pigment: heavily pigmented on head and body, only species with pigment on branchiostegals based on one larva

Diagnostic characters: from other istiophorids by presence of pigment on branchiostegals, long snout in juveniles

Illustrations:

*Tetrapturus pfluegeri*

ISTIOPHORIDAE

ISTIOPHORIDAE

Makaira nigricans Lacepede

MERISTICS

Vertebrae	
Precaudal	11
Caudal	13
Total	24
Number of fin spines and rays	
First Dorsal	41-43
Second Dorsal	6-7
Dorsal Finlets	0
Anal	13-15
Second Anal	6-7
Anal Finlets	0
Pectoral	18-21
Pelvic	3
Caudal	
Dorsal Secondary	
Principal	9+8
Ventral Secondary	
Total	
Gillrakers on first arch	
Upper	
Lower	
Total	Absent
Branchiostegals	

LIFE HISTORY

Range: throughout area  
Habitat: epipelagic, oceanic  
ELH pattern: oviparous, buoyant eggs, pelagic larvae  
Spawning      Season: warm months  
                 Area: Florida Straits, Gulf,  
   east of Bahamas  
                 Mode:  
                 Migration: long, trans-Atlantic  
Fecundity  
Age at first maturity: 44 kg  
Longevity: 9 years<sup>+</sup> ( E. Scott, pers. commun.)

Literature: Rivas 1975

EARLY LIFE HISTORY DESCRIPTION

EGGS: unknown  
Diameter  
No. of Oil Globules  
Oil Globule Diameter  
Yolk  
Shell  
Hatch Size  
Incubation  
Pigment

Diagnostic characters

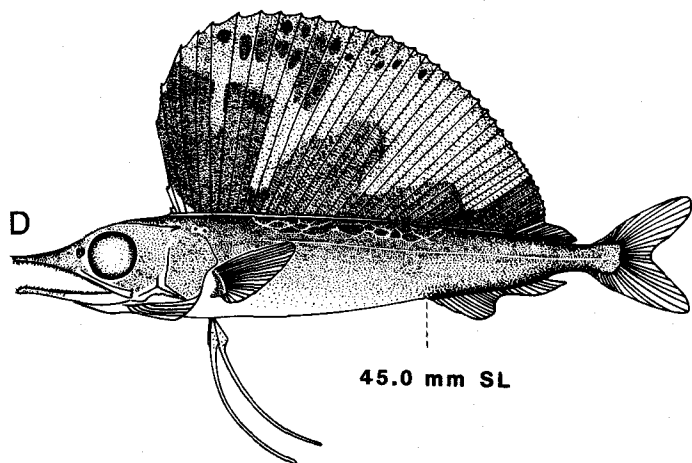
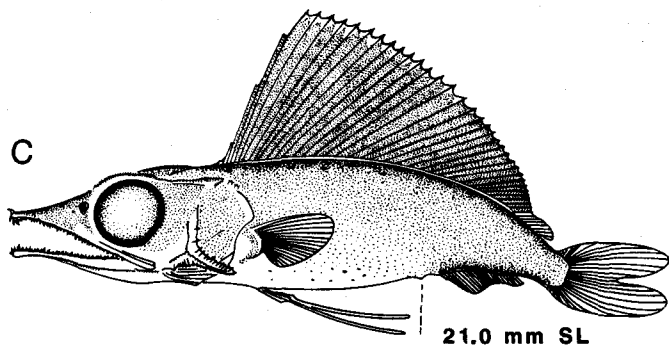
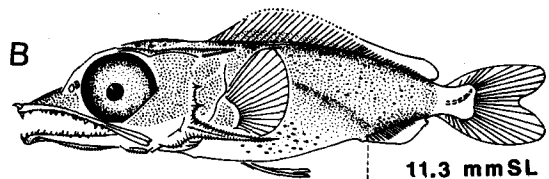
LARVAE

Length at flexion  
Length at transformation  
Sequence of fin development: caudal, dorsal, anal, pectoral, pelvic  
Pigment: heavily pigmented on head and body with few pigment spots restricted to tip of lower jaw, none on branchiostegals  
Diagnostic characters: from other istiophorids by precaudal/caudal number, little pigment by lower jaw, and short snout with projecting anterior orbitals

Illustrations: B-D from Gehringer 1956

*Makaira nigricans*

ISTIOPHORIDAE





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#### FAMILY XIPHIIDAE

This family has only one, very distinct species Xiphias gladius. It is easily identified and could only be confused with an istiophorid. In early stages it is not as darkly pigmented as istiophorids, it is more elongate, and bears the distinct prickle-like scales on the body. Other larvae with prickles are chiasmodontids, but they do not have elongate snouts. Eggs and early stages were reared by Sanzo (1922) and later stage larvae and small juveniles are common in surface collections. The bill is very long and the body is round in cross-section and elongate thus making separation from istiophorids a very simple matter.

## XIPHIIDAE

Xiphias gladius Linnaeus

## MERISTICS

Vertebrae	
Precaudal	15-16
Caudal	10-11
Total	25-27
Number of fin spines and rays	
First Dorsal	38-45
Second Dorsal	4-5
Dorsal Finlets	0
Total Dorsal Elements	44-49 (juveniles)
Anal	12-16
Second Anal	3-4
Anal Finlets	0
Total Ventral Elements	16-19 (juveniles)
Pectoral	16-19 (mean 17.6)
Pelvic	Absent
Caudal	
Dorsal Secondary	8-10
Principal	9+8
Ventral Secondary	9-11
Total	34-38
Gillrakers on first arch	
Upper	
Lower	
Total	None
Branchiostegals	7-8

## EARLY LIFE HISTORY DESCRIPTION

## EGGS

Diameter: 1.6-1.8 mm  
 No. of Oil Globules: one  
 Oil Globule Diameter: 0.4 mm  
 Yolk: vesicular  
 Shell: clear  
 Hatch Size: 4.2 mm  
 Incubation: 2.5 days  
 Pigment: pigment on embryo, oil globule, and yolk;  
           straw color in life giving egg dirty  
           white appearance

Diagnostic characters: size and pigmentation,  
                                   24 myomeres on embryo

## LARVAE

Length at flexion: ca. 12 mm  
 Length at transformation  
 Sequence of fin development: caudal, second dorsal,  
                                   anal, first dorsal, pectoral  
 Pigment: heavily pigmented on head and body  
 Diagnostic characters: from istiophorids by pigment  
                                   pattern and body shape. Large, prickly scales  
                                   are very evident on larger larvae and juveniles

## LIFE HISTORY

Illustrations: A, G from Sanzo 1922; B from Collette  
 et al. 1984; C-E from Fahay 1983; H-I from  
 Potthoff and Kelley 1982.

Range: throughout area

Habitat: epi-mesopelagic, oceanic

ELH pattern: oviparous, buoyant eggs, pelagic larvae

Spawning               Season: throughout the year

Area: throughout area

Mode: pairing suspected

Migration: probably limited

Fecundity

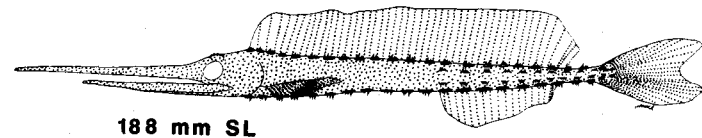
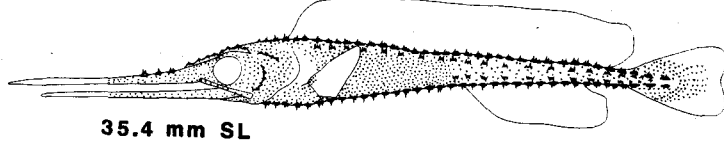
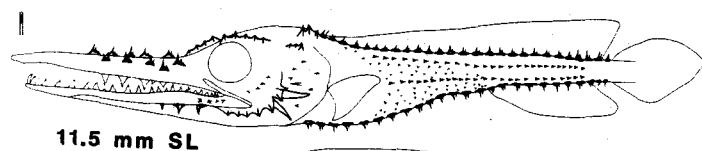
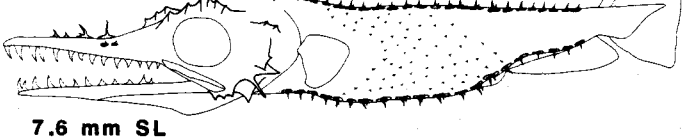
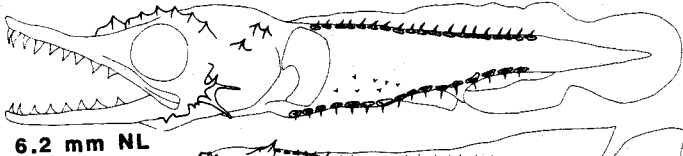
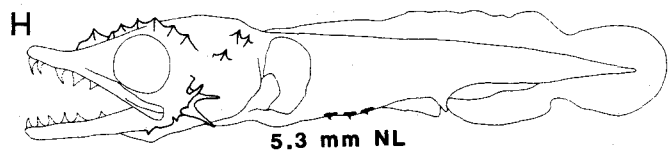
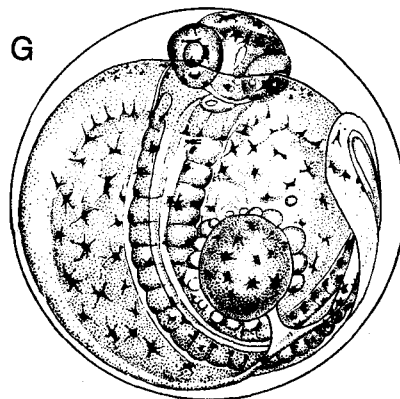
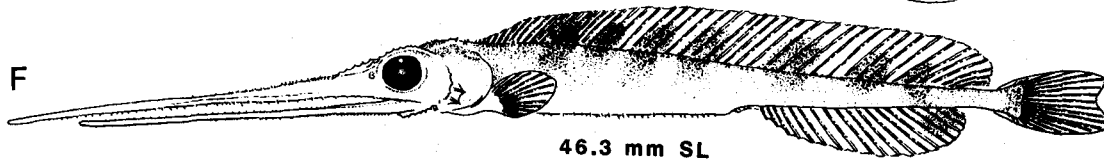
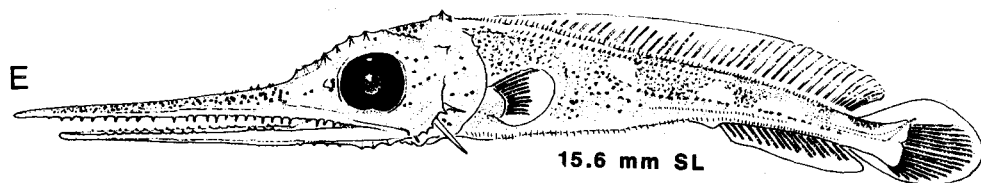
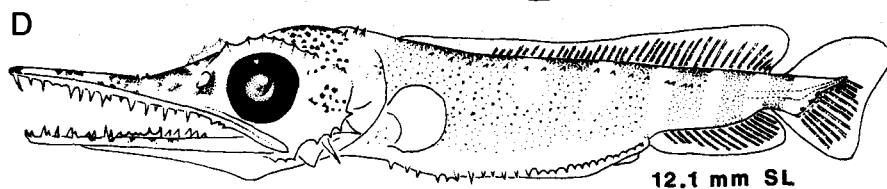
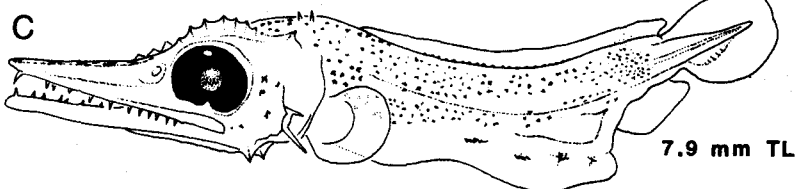
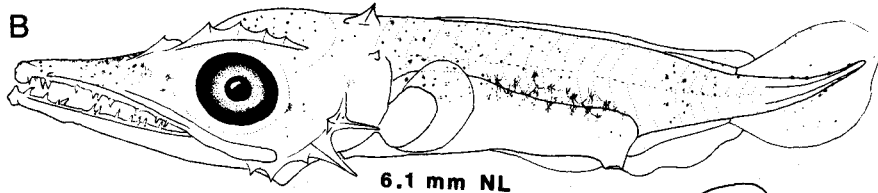
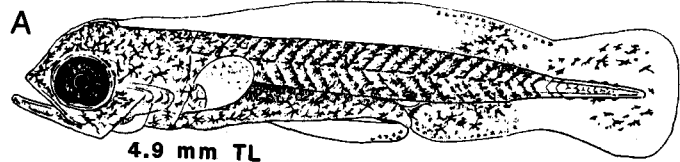
Age at first maturity: 21 kg for males, 74 kg for females

Longevity: 9<sup>+</sup> years

Literature: Palko et al. 1981

# *Xiphias gladius*

## XIPHIIDAE



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